Supplementary Materials for:

Northern Borneo stalagmite records reveal West Pacific hydroclimate across MIS 5 and 6

Supplementary Materials:
Materials and Methods
Figures S1-S14
Tables S1-S4
References

S1. Field Site

All stalagmites in the Mulu composite record were collected from Gunung Mulu and Gunung Buda National Parks (4°6'N, 114°53'E) (Fig. S1). Three outcrops of Melinau limestone, covered with dense tropical rainforest, are located on the western shale and sandstone slopes of 2375m high Gunung Mulu (Fig. S1). The sample collection chambers are ~120-200 meters above sea level (masl) with variable overlying limestone depths of ~50-150m. Fairy City (FC) and Secret Chamber (SC) are two chambers within the passages of Clearwater Cave. Clearwater Cave and Whiterock Cave (WR) are found on the western slopes of Gunung Api, while Snail Shell Cave (SSC and SCH), Green Cathedral Cave (GC), and Bukit Assam Cave (BA) are located on the western slopes of Gunung Buda (Fig. S1). New stalagmites analyzed in this study include FC12-12 (Fig. S2), FC12-14 (Fig. S3), and FC12-15 (Fig. S4) from Fairy City chamber and WR12-01 (Fig. S5) and WR12-12 (Fig. S6) from Whiterock Cave. Analysis was also continued into the lower sections of SC03 (Fig. S7) and SC02 (Fig. S8), which were collected from Secret chamber within Clearwater cave during a 2006 expedition (see Fig. S1).

S2. ICP-MS U/Th age measurements

Measured [^{238}U], [^{232}Th], δ^{234}U, (^{230}Th/^{238}U)$_A$, and (^{230}Th/^{232}U)$_A$ are reported in Table S1 for all samples in this study. U-series chemistry and MC-ICP-MS data collection methods follow those described in Partin et al. (2007). The reported ages and their 2σ uncertainties were estimated using a Monte Carlo simulation that accounts for the errors in all isotope ratios and the uncertainty in the initial $^{230}Th/^{232}Th$ ratio. The Matlab script for the Monte Carlo simulation can be downloaded from Prof. Jess Adkin's website: http://web.gps.caltech.edu/~jess/.

S3. Isochrons

Three or more co-precipitated samples with variable ($^{238}U/^{232}Th$) have been analyzed over the past 10 years on multiple stalagmites from multiple cave chambers within Gunung Buda and Gunung Mulu. There are a total of 25 isochron-derived initial ($^{230}Th/^{232}Th$) ratios measured in Gunung Buda/Gunung Mulu stalagmites.

Figure S9 shows an example of isochron sampling locations on a slabbed stalagmite. Samples are drilled along a growth lamina to produce multiple samples with the same age but variable ($^{230}Th/^{232}Th$) ratios. Variable ($^{230}Th/^{232}Th$) ratios result from the idea that samples drilled further from the central growth axis have greater detrital contamination than the "cleaner" central samples. Multiple sampling along a growth lamina is challenging in low-uranium-concentration Mulu stalagmites. Additional difficulties arise when sampling further from the central growth axis. As growth layers pinch together toward the outer edges of the stalagmite, it is more likely that drilling near the edges will clip other growth layers and add extra scatter to the isochron plots.

Figure S10 shows one of the XY pairs of the Osmond Type-II isochron diagram (($^{230}Th/^{238}U$) v. ($^{232}Th/^{238}U$)) for each of the 25 sampling spots. Also shown is the isochron's ($^{230}Th/^{232}Th)_{init}$ value and the square $\sqrt{(MSWD)}$, both computed using ISOPLOT 3.72 (Ludwig, 1991). Error ellipses are able to capture analytical uncertainties, but the degree of scatter about the best-fit line, coupled to the spread of the data points along the axes, determines the uncertainty in the initial $^{230}Th/^{232}Th$ ratio. All isochron isotopic ratios [$(^{232}Th/^{238}U)_A$, $(^{230}Th/^{238}U)_A$, and $(^{234}U/^{238}U)_A$] and their associated analytical 2σ errors, as well as MSWD values, are listed in Table S2. Isochrons from Fairy City and Whiterock are new for this study, while all other isochron data has been previously published in Partin et al. (2007) and Carolin et al. (2013). All isotopic ratios listed in Table S2 have been re-calculated using the new half-lives of ^{234}U and ^{230}Th provided in Cheng et al (2013).

The weighted means for the detrital $^{230}Th/^{232}Th$ concentration are calculated for each stalagmite with the weighting factor assigned as the inverse of the 1σ errors from each isochron (Table S3). The weighted standard deviation is equal to the inverse of the sum of the weights for each cave system. Un-weighted means and standard deviations are also calculated for comparison (Table S3). There is a large difference between the weighted standard deviation and the spread of the initial values from each line (the "un-weighted standard deviation"). For the final estimates of the detrital $^{230}Th/^{232}Th$ ratio (excluding Fairy City, which is discussed below) we use the calculated weighted means and an uncertainty that lies between the simple population spread and the weighted uncertainty.

Fairy City stalagmites are assigned an average detrital atomic $^{230}Th/^{232}Th$ ratio = 78 ± 42 ppm (2σ errors). In the case of the Fairy City stalagmites, instead of choosing a weighted mean value between the two isochron values, we chose a value that falls between the two measured Fairy City isochrons, 36 ± 42 ppm and 108 ± 534 ppm, and which allows Fairy City stalagmite records to align well with the other Mulu stalagmite records.

Two Whiterock stalagmite isochrons resulted in detrital atomic $^{230}Th/^{232}Th$ ratio = 453 ± 1565 ppm and -103 ± 518 ppm. As such, Whiterock stalagmite isochrons could not be used to calculate an initial detrital $^{230}Th/^{232}Th$ ratio. To circumvent this problem, we compared overlapping $\delta^{18}O$ timeseries from our two Whiterock stalagmites using a spread of initial $^{230}Th/^{232}Th$ ratios. We used the $\delta^{18}O$ timeseries near ages of low detrital contamination as targets, and assumed that both stalagmites' $\delta^{18}O$ records trend up toward depleted $\delta^{18}O$ values concurrently over the penultimate deglaciation. The initial atomic $^{230}Th/^{232}Th$ for Whiterock that produced the best fit between the two records is 60 ppm.

S4. Age Models and growth hiatuses

The age-depth plots for FC12-12, FC12-14, FC12-15, WR12-01, WR12-12, SC03, and SC02 are provided in Figures S2 through S8 and compared in Figure S11. The age models for the stalagmites in this study were constructed using the StalAge algorithm (Scholz and Hoffman, 2011). One exception is FC12-14's upper younger section, which is separated from the rest of the record by a 40-ky hiatus. This section only contains two U-series ages of 74.4 and 87.8 kybp, making it unfit for a StalAge Monte Carlo simulation. This portion of the record overlaps with two other previously published stalagmite records (SCO3 and SC02 (Carolin et al., 2013)), and a linear interpolation between chosen ages within the original ages' calculated 2σ age error (73.8 and 87.3 kybp) produced a well-fit overlapping record.

Age models published in Partin et al. (2007) and Carolin et al. (2013) were re-calculated using updated half-lives of ^{234}U and ^{230}Th provided in Cheng et al (2013). All revised age models can be found at ftp://ftp.ncdc.noaa.gov/pub/data/paleo/speleothem/pacific/gunung-mulu2015.txt.

Original U-series ages with 2σ age error are plotted on top of the calculated Stalage model with 95% confidence intervals shown (see Figs. S2-S8 and S11). For all records, if a repeat dating sample was drilled directly above or below a previously analyzed sample, the date with the smaller age error was used in constructing the age model.

Following Carolin et al. (2013), most potential hiatuses were identified in the stalagmite slab from optical evidence of a cessation of carbonate accumulation (dark or white layer), and by U-series ages drilled immediately above and below such layers. Additional hiatuses were inferred wherever growth rates fell below 0.5 µm/yr in Whiterock and Fairy City stalagmites, as calculated from the StalAge model. Any $\delta^{18}O$ samples that fell on a potential hiatus were removed from the final oxygen isotope time series, as they are associated with large dating uncertainties. In the cases where hiatuses are inferred from dramatic changes in growth rate between two U-series dates, and where the hiatus is visible as a narrow band in the stalagmite images, growth rates from adjacent dates were linearly interpolated to the hiatus layer from either side.

S5. Evidence of Mulu $\delta^{18}O$ equilibrium calcite precipitation

A modern-day study at Gunung Buda and Gunung Mulu measures present-day rainwater $\delta^{18}O$ equal to -6.8 ± 1.1‰SMOW and fast and slow dripwaters to be -6.6 ± 1.0‰SMOW and -7.0 ± 1.1‰SMOW, respectively, which agree within error (Moerman et al., 2013). Modern calcite from one of the stalagmites used for this project is approximately -9.1‰PDB, which is in good agreement with the calculated $\delta^{18}O_{calcite}$ (-8.6‰PDB) at equilibrium with T = 26°C (299K) as measured in Cobb et al. (2007). Further evidence of calcite precipitation under equilibrium conditions at Mulu is provided in Partin et al. (2007) and Meckler et al. (2012), where it was demonstrated that the Gunung Buda and Gunung Mulu stalagmites analyzed passed the "Hendy test" ($\delta^{18}O$ did not vary significantly across a single growth layer). Dorale and Liu (2009) argue that the only method that can be used to ensure that isotopic equilibrium is maintained during calcite formation is to replicate oxygen isotopic values in two or more stalagmites. If the isotopic profiles are similar it is concluded that the calcite was formed under equilibrium conditions. The millennial scale $\delta^{18}O$ variability of the low-detrital contamination stalagmites in the 160ky composite record (extracted from caves spanning over 20 km) is well aligned (Carolin et al., 2013; this study) within age error, indicating that the variability is due to regional climate changes associated with rainfall $\delta^{18}O$ variability and not a result of calcite precipitation at disequilibrium states.

S6. Spectral Analysis

To create a continuous, evenly-spaced composite record for spectral analysis, averages of all measured Mulu stalagmites' $\delta^{18}O$ were calculated using 100-yr boxcar bins. Any gap in the composite record was filled by linearly interpolating between filled boxcar bins. Spectral analysis (Thomson, 1982; Percival and Walden, 1993) was performed using a single discrete prolate spheroidal sequences (DPSS) taper method (Matlab script provided by Prof. Peter Huybers, phuybers@fas.harvard.edu). The time bandwidth product (NW) was set to 1. The 95% confidence interval was computed by multiplying the power spectrum of a sequence of red noise samples of length N by the chi-squared value at the 95% confidence level with 2 degrees of freedom. Figure 5 shows the percent power density function over various frequencies. The spectral analysis confirms a strong precessional signal in the Mulu record, with a muted peak at the obliquity period, 41ky, though it is not greater than red noise power density equivalent.

To investigate the 100 ky cycle on the full 570 ky Mulu stalagmite $\delta^{18}O$ record, the gap (160-210kyBP) in the 0-570 kybp record was filled with both a linear interpolation and a drawn-in curve that reflects other similar parts of the record. Additionally, the temperature-corrected marine record of mean ocean water isotopes over the past 429ky was subtracted from the 0-429 kyBP stalagmite record (Waelbroeck et al., 2002). A spectral analysis of this corrected 429ky-record shows an almost insignificant peak at the 100 ky period (though above red noise) (Fig. S13).

Multi-taper method coherence using adaptive weighting and corrections for inherent bias to coherence estimates was performed to calculate the coherence and phase lag between insolation and various climate proxies with precessional signals (Fig. 5b). The number of windows (NW) was set to 1.5 for the calculations. The insolation curve used for the coherence / phase lag calculations was bandpass-filtered precessional 4°N insolation strength, averaged between June 1 and August 31 (Berger, 1978). Matlab script was provided by Prof. Peter Huybers (phuybers@fas.harvard.edu).

S7. Removal of ice volume effects

To remove ice-volume effects in the 0-160kybp Mulu composite record we utilize a temperature-corrected Atlantic-Pacific-Indian benthic-$\delta^{18}O$ stack (Waelbroeck et al., 2002), which captures the effect of global ice volume growth and decay on whole-ocean seawater, and aligns reasonably well with U-Th dated coral relative sea level (RSL) records for this time interval (eg. Medina-Elizalde, 2013; see Figure S14 for detailed coral sea level and benthic $\delta^{18}O$ record comparison over Termination 1 and Termination 2). Original and corrected $\delta^{18}O$ with mean ocean water variability due to ice volume growth/decay removed are provided in Table S4, and can be downloaded at ftp://ftp.ncdc.noaa.gov/pub/data/paleo/speleothem/pacific/gunung-mulu2015.txt. These data are plotted in Figure 4 along with the Waelbroeck et al., 2002 benthic-$\delta^{18}O$ stack.

S8. Sea level records over Terminations 1 and 2

A comprehensive coral sea level and benthic $\delta^{18}O$ record comparison over Termination 1 and Termination 2 is provided in Figure S14. References are listed in the figure caption. Coral ages are as originally published. Samples with $\delta^{234}U < 135.7‰$ and $\delta^{234}U > 155.7‰$ have been removed. Coral records from Tahiti (Thomas et al., 2009) and Barbados (Gallup et al., 2002), as well as U/Th dating of Bahaman sediments (Henderson and Slowey, 2000) support a penultimate deglacial sea level rise with a midpoint of ~136 kybp. Several coral records further agree that the sea-level highstand during the last interglacial began ~130 kybp (see Fig. S14).

S9. Ice core age models

For Termination 1, EDC CO_2 records (Monnin et al., 2001) are plotted on the EDC3 timescale (Parrenin et al., 2007) and Taylor Dome CO_2 records (Indermühle et al., 1999) on the st9810 timescale (Steig et al., 2000). Vostok ice core δD records (Petit et al., 1999) are plotted on the Lemieux-Dudon timescale (2010). Termination 2 ice core records are set on the Kawamura et al. (2007) timescale (DFO-2006) then shifted 1.85ky younger to align the ice core record's abrupt methane increase with the Chinese stalagmite records' abrupt shift to more negative $\delta^{18}O$ values in at 128.95 ± 0.10 ky (Cheng et al., 2009). For the 0-600 kybp full record, Vostok CO_2 records (Petit et al., 1999) are plotted on the EDC3 timescale (Parrenin et al., 2007) (Fig. 7).

S10. Temperature effects: H1 and H11 comparison

Temperature and mean ocean water $\delta^{18}O$ due to ice volume effects are quantified in the table below.

Period	Mean Ocean (‰)	Temp. Effect (‰)	Mulu $\delta^{18}O_{orig}$ (‰)	$\delta^{18}O_{orig}$- $\delta^{18}O_{sw}$ (‰)	$\delta^{18}O_{orig}$ – $\delta^{18}O_{sw}$ – $\delta^{18}O_{temp}$ (‰)	Change from present (‰)
Present	0	0	-9.4	-9.4	-9.4	na
H1 (16.3 kybp)	+0.90	+0.35 (-1.6^{o}C)	-6.8	-7.7	-8.05	+1.35
H11 (130.6 kybp)	+0.15	+0.11 (-0.5^{o}C)	-6.4	-6.55	-6.66	+2.74

The mean ocean change is +0.9‰ at H1 and +0.15‰ at H2 (see section S6). Based on SST records derived from marine sediment Mg/Ca ratios, at the H1 enrichment (16.3 kybp) WPWP SSTs were ~1.6^{o}C cooler than present (eg. Koutavas and Joanides, 2012), while at the H11 enrichment (130.6 kybp) WPWP SST had already risen from glacial values significantly, and were only were ~0.5^{o}C cooler than present (Lea et al., 2000; Visser et al., 2003). Given a temperature-dependent calcite fractionation of -0.22 ‰/°C (Epstein et al., 1953) and assuming cave temperatures to vary synchronously with regional ocean temperatures, Mulu stalagmite $\delta^{18}O$, with both calcite precipitation temperature and ice-volume effects removed, is roughly twice as enriched at H11 than H1.

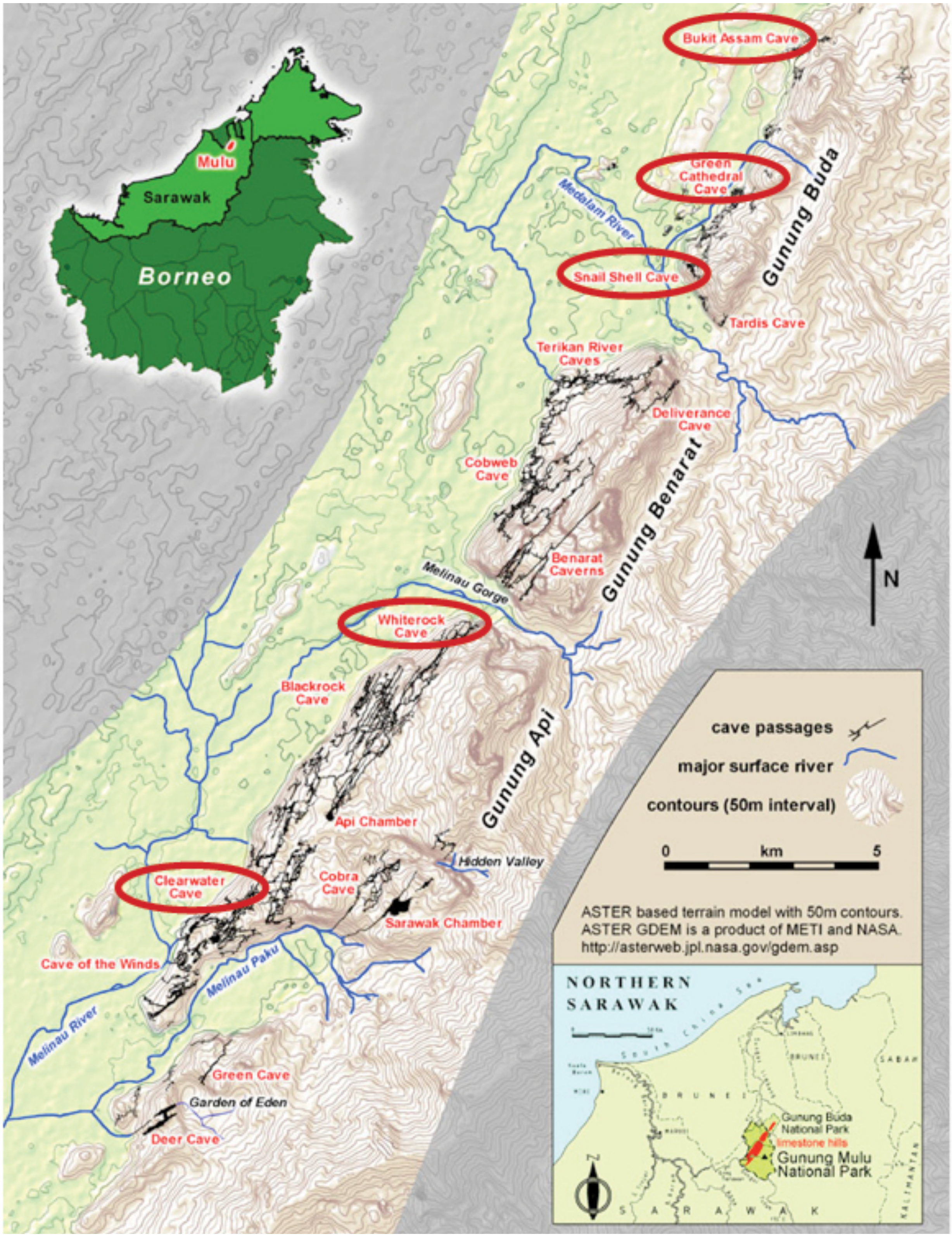


Fig. S1. Caves of Gunung Mulu National Park with cave study sites indicated. From *J. Wooldridge and T. Waltham, in Encyclopedia of Caves 2nd Ed. (2012).*

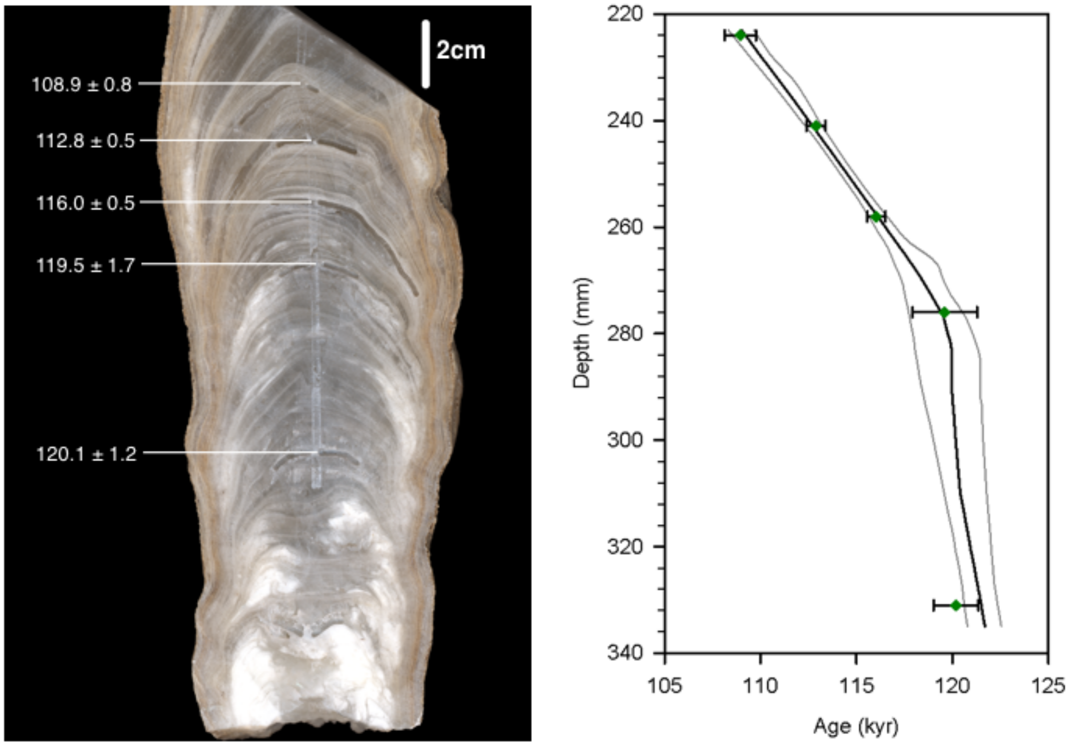


Figure S2. (left) High-resolution scan image of FC12-12, showing original U-series dates and 2σ age error reported in ky. (right) Age-depth plot (see Table S1). Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011).

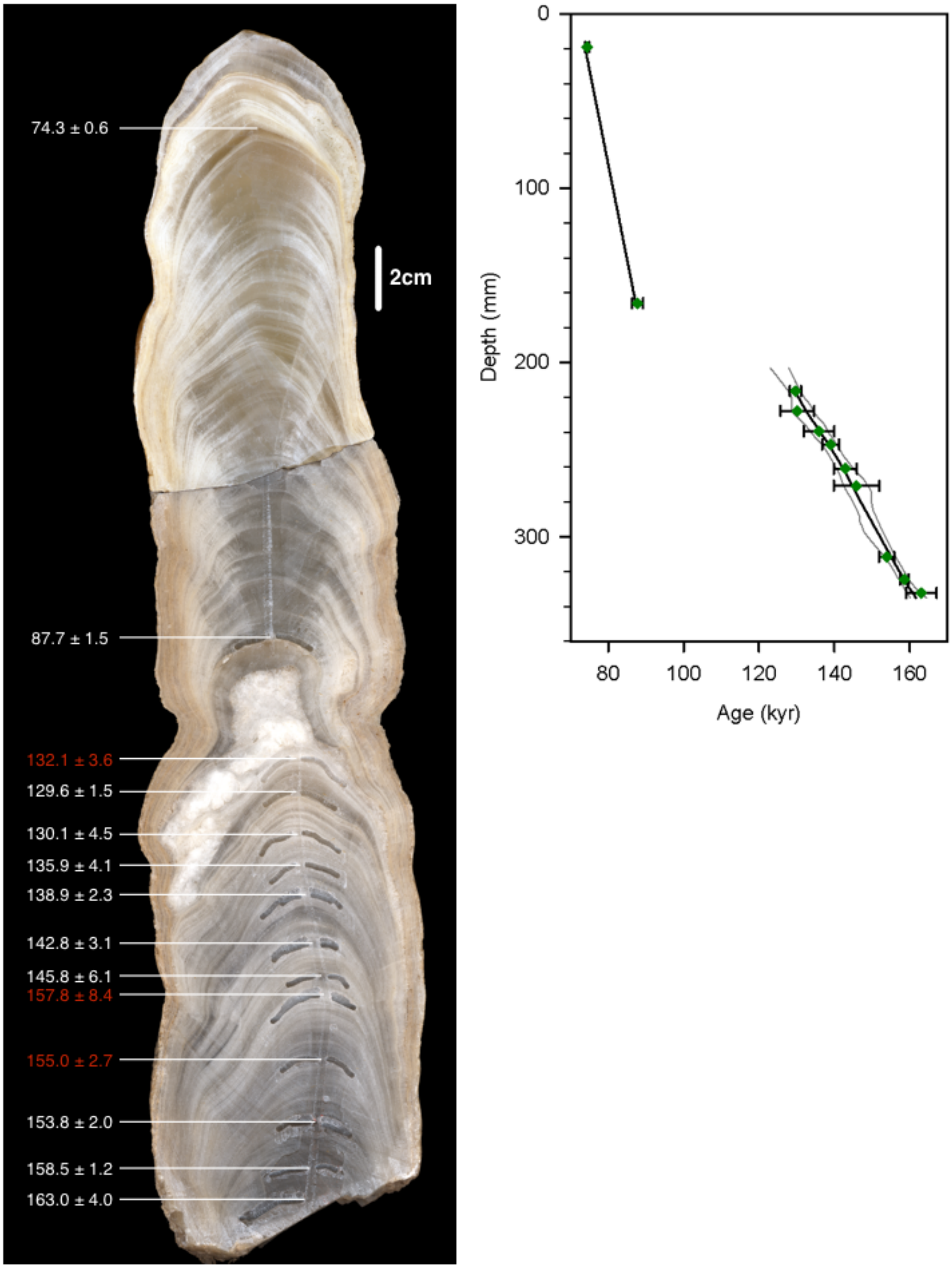


Figure S3. (left) High-resolution scan image of FC12-14, showing original U-series dates and 2σ age error reported in ky. (right) Age-depth plot. Data points not included in the age model are in red on image scan not shown in plot (see Table S1). Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011).

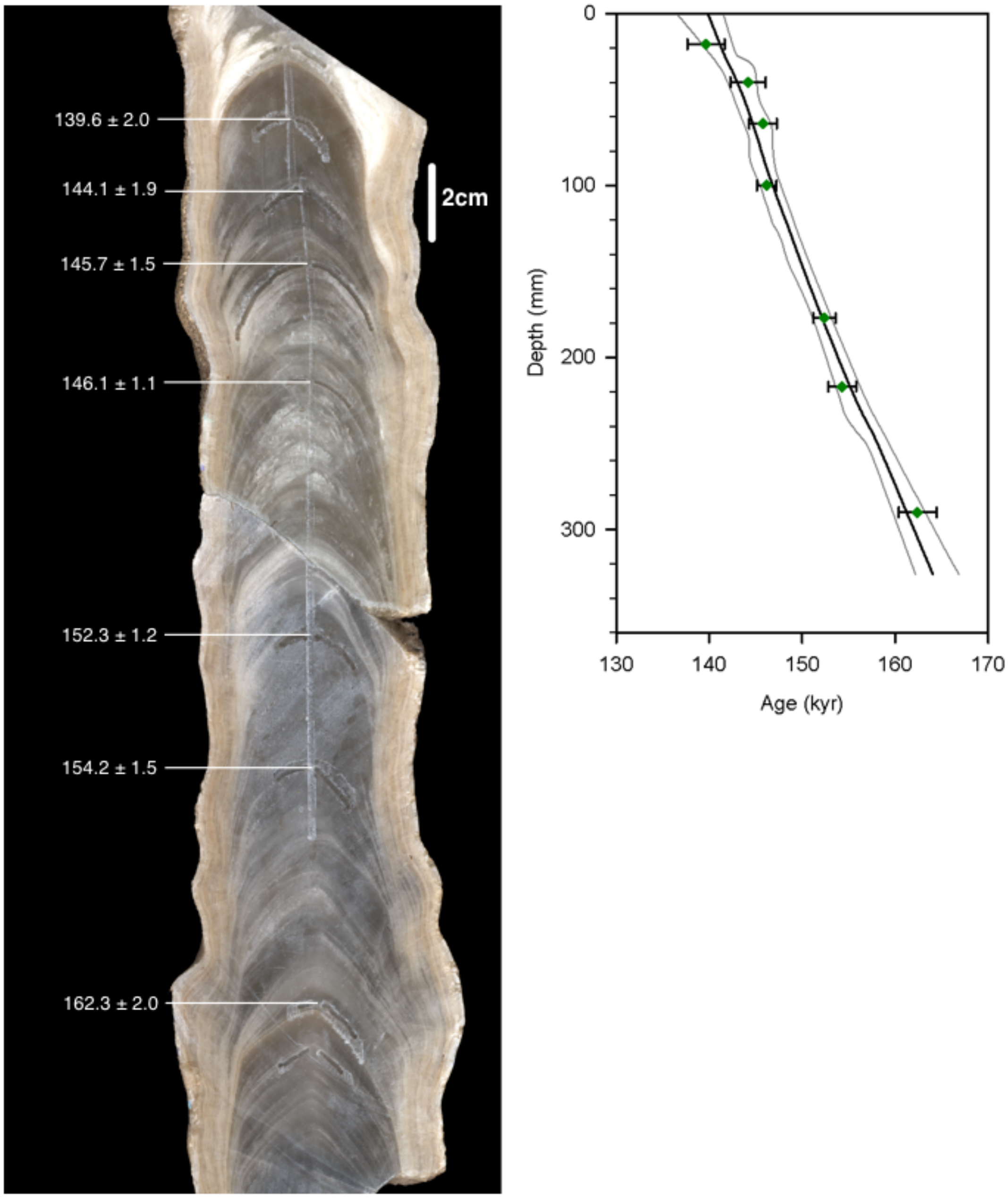


Figure S4. (left) High-resolution scan image of FC12-15, showing original U-series dates and 2σ age error reported in ky. (right) Age-depth plot (see Table S1). Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011).

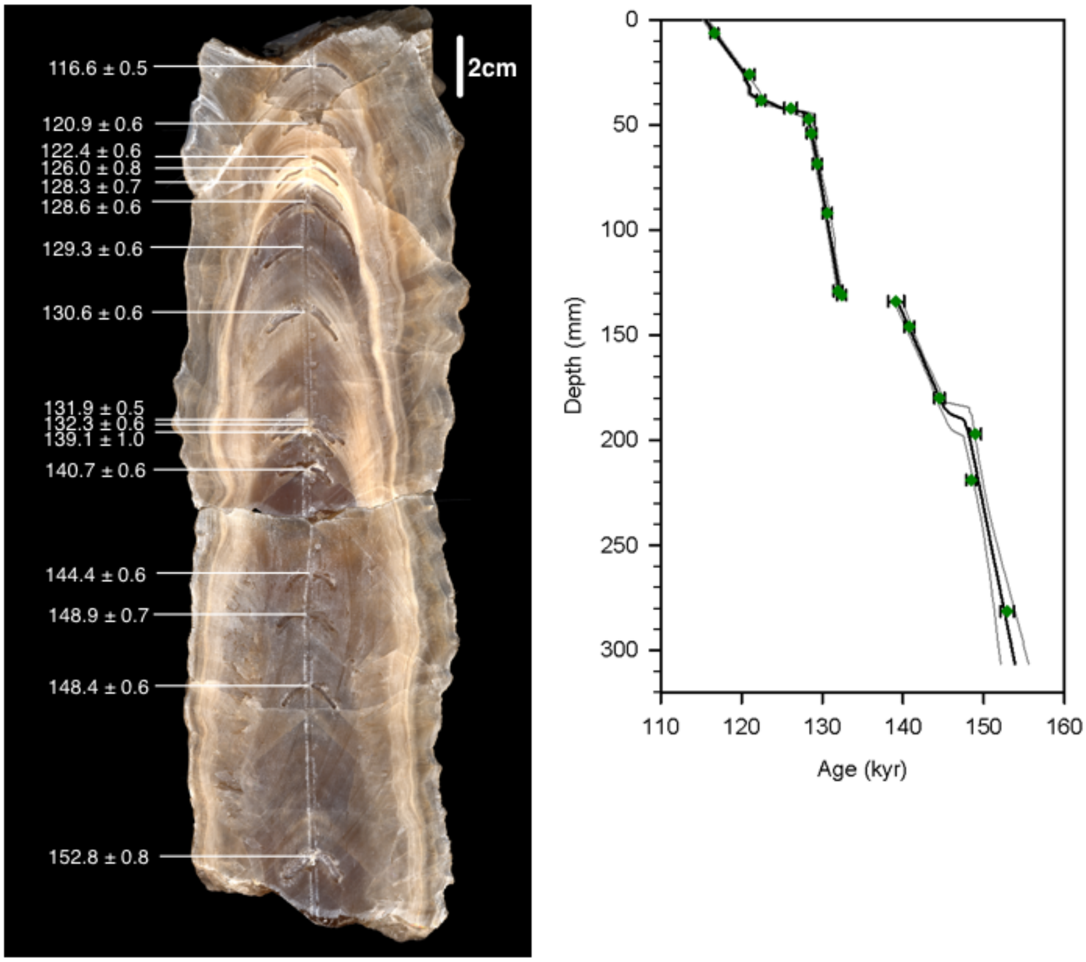


Figure S5. (left) High-resolution scan image of WR12-01, showing original U-series dates and 2σ age error reported in kyr. (right) Age-depth plot (see Table S1). Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011).

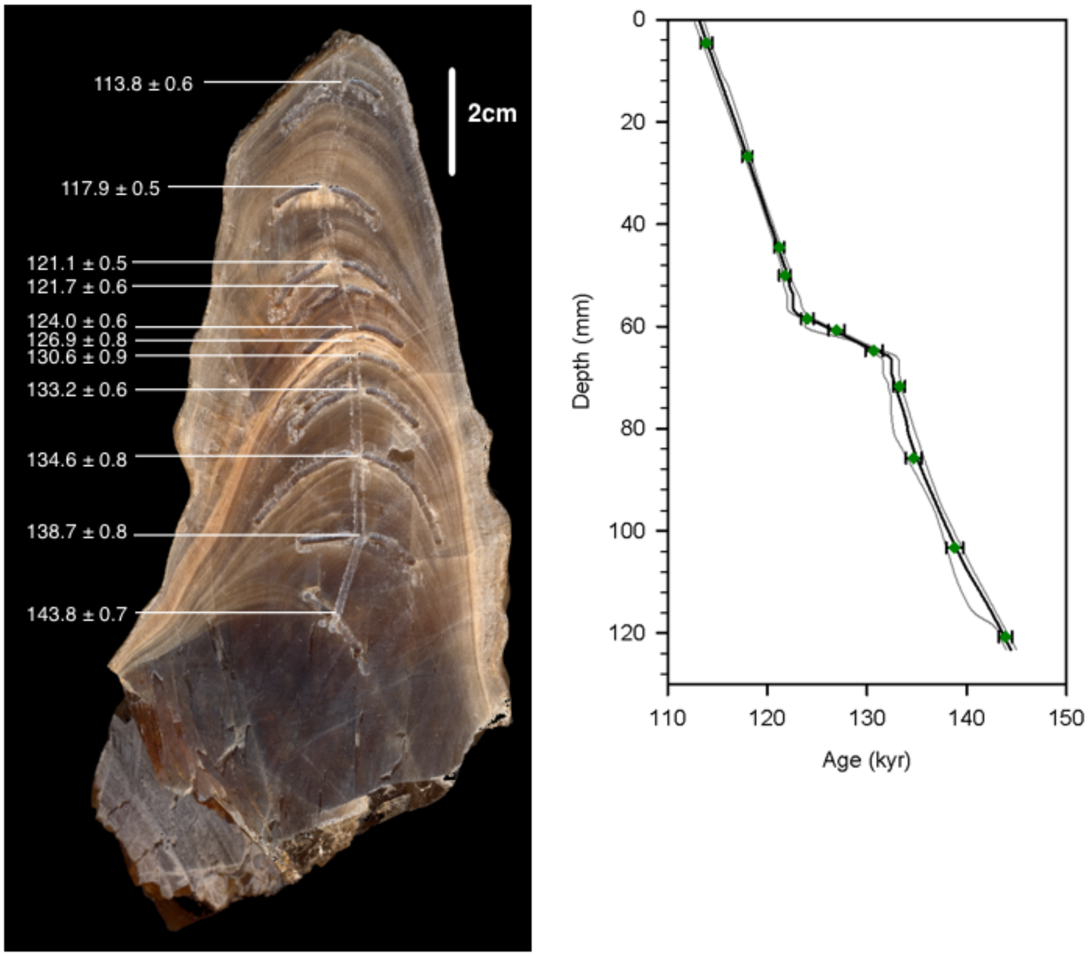


Figure S6. (left) High-resolution scan image of lower WR12-12, showing original U-series dates and 2σ age error reported in ky. (right) Age-depth plot (see Table S1). Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011).

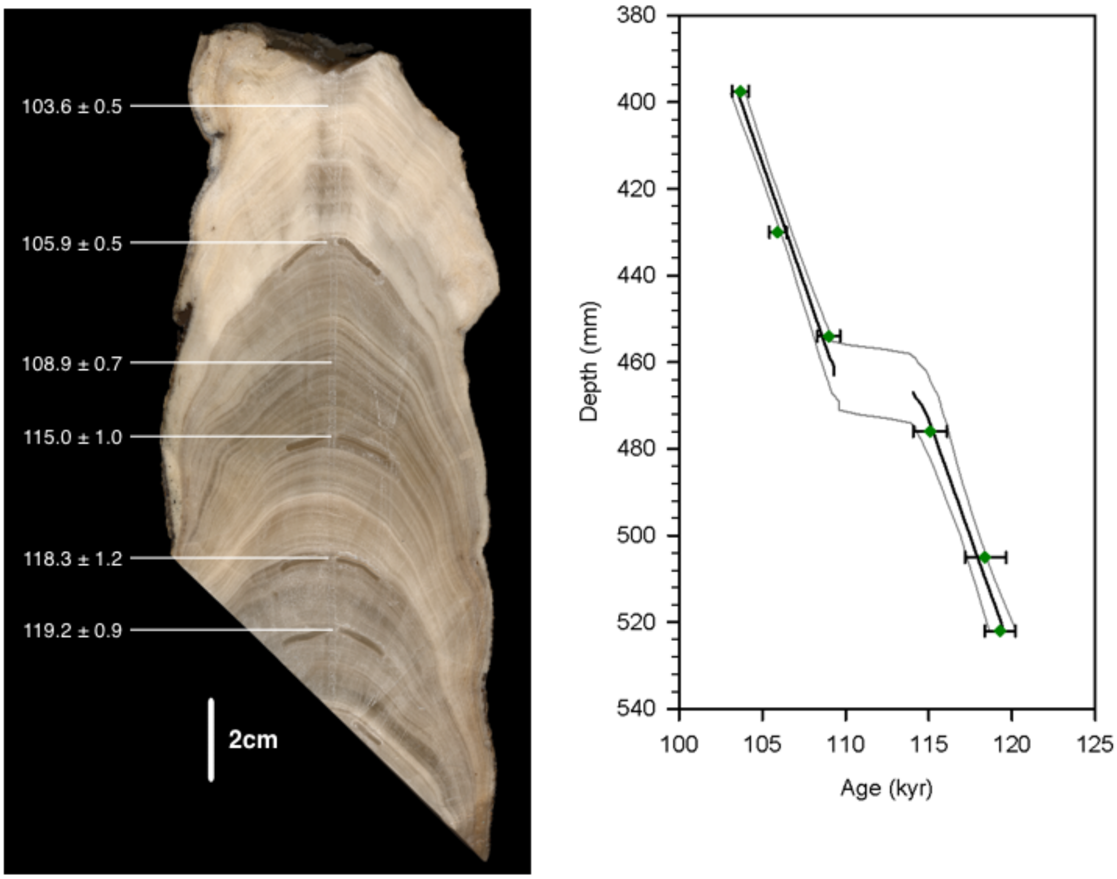


Figure S7. (left) High-resolution scan image of lower SC03, showing original U-series dates and 2σ age error reported in ky. (right) Age-depth plot (see Table S1). Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011).

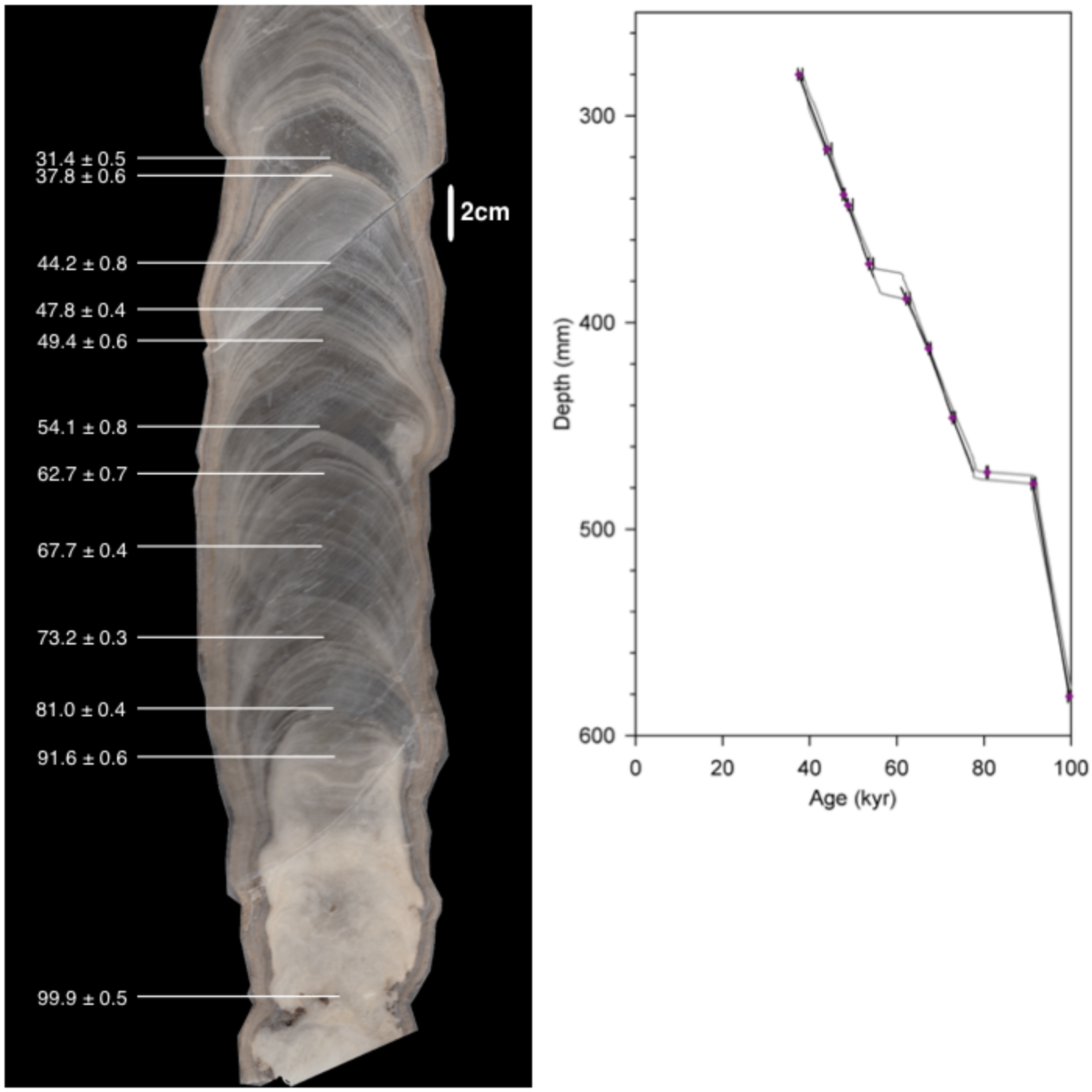


Figure S8. (left) High-resolution scan image of SC02, showing original U-series dates and 2σ age error reported in ky. (right) Age-depth plot. Error bars represent 2σ dating uncertainties. Black line indicates the StalAge age-depth model. Grey outer curves indicate 95% confidence interval endpoints for an ensemble of age models produced using StalAge (Scholz and Hoffman, 2011). *Adopted from Carolin et al., 2013 Supplemental Figure S6.*

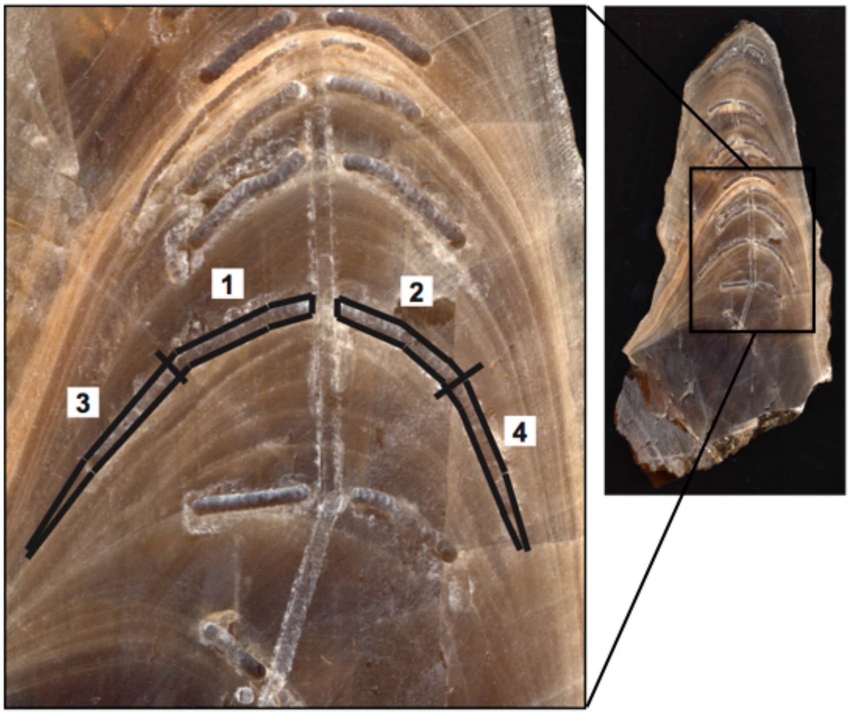
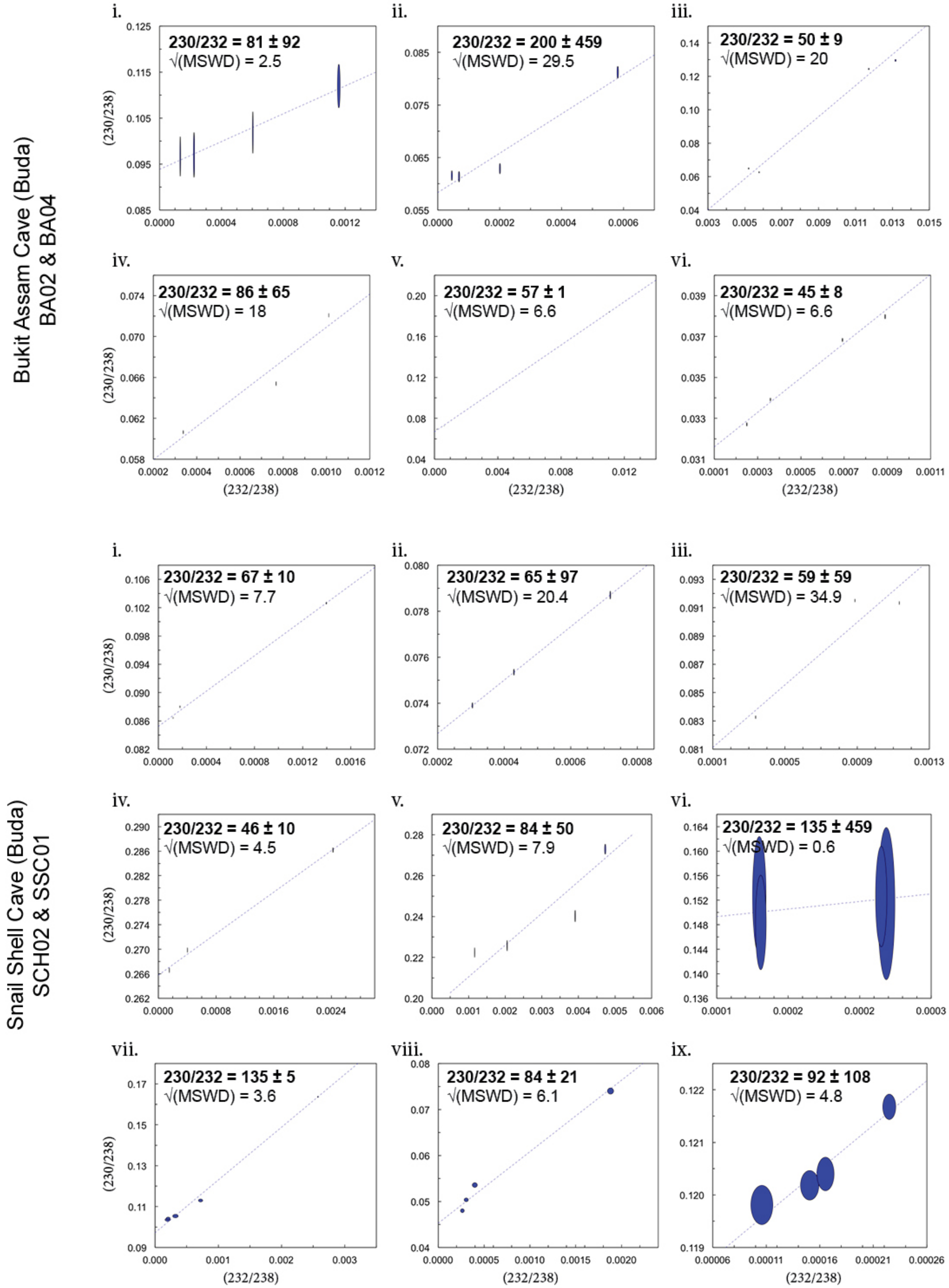


Figure S9. Mapped isochron drill spots along a single growth layer within a stalagmite collected from Whiterock (WR12-12).


Bukit Assam Cave (Buda)
BA02 & BA04
i.
230/232 = 81 ± 92
√(MSWD) = 2.5
ii.
230/232 = 200 ± 459
√(MSWD) = 29.5
iii.
230/232 = 50 ± 9
√(MSWD) = 20
iv.
230/232 = 86 ± 65
√(MSWD) = 18
v.
230/232 = 57 ± 1
√(MSWD) = 6.6
vi.
230/232 = 45 ± 8
√(MSWD) = 6.6
(230/238)
(232/238)
Snail Shell Cave (Buda)
SCH02 & SSC01
i.
230/232 = 67 ± 10
√(MSWD) = 7.7
ii.
230/232 = 65 ± 97
√(MSWD) = 20.4
iii.
230/232 = 59 ± 59
√(MSWD) = 34.9
iv.
230/232 = 46 ± 10
√(MSWD) = 4.5
v.
230/232 = 84 ± 50
√(MSWD) = 7.9
vi.
230/232 = 135 ± 459
√(MSWD) = 0.6
vii.
230/232 = 135 ± 5
√(MSWD) = 3.6
viii.
230/232 = 84 ± 21
√(MSWD) = 6.1
ix.
230/232 = 92 ± 108
√(MSWD) = 4.8

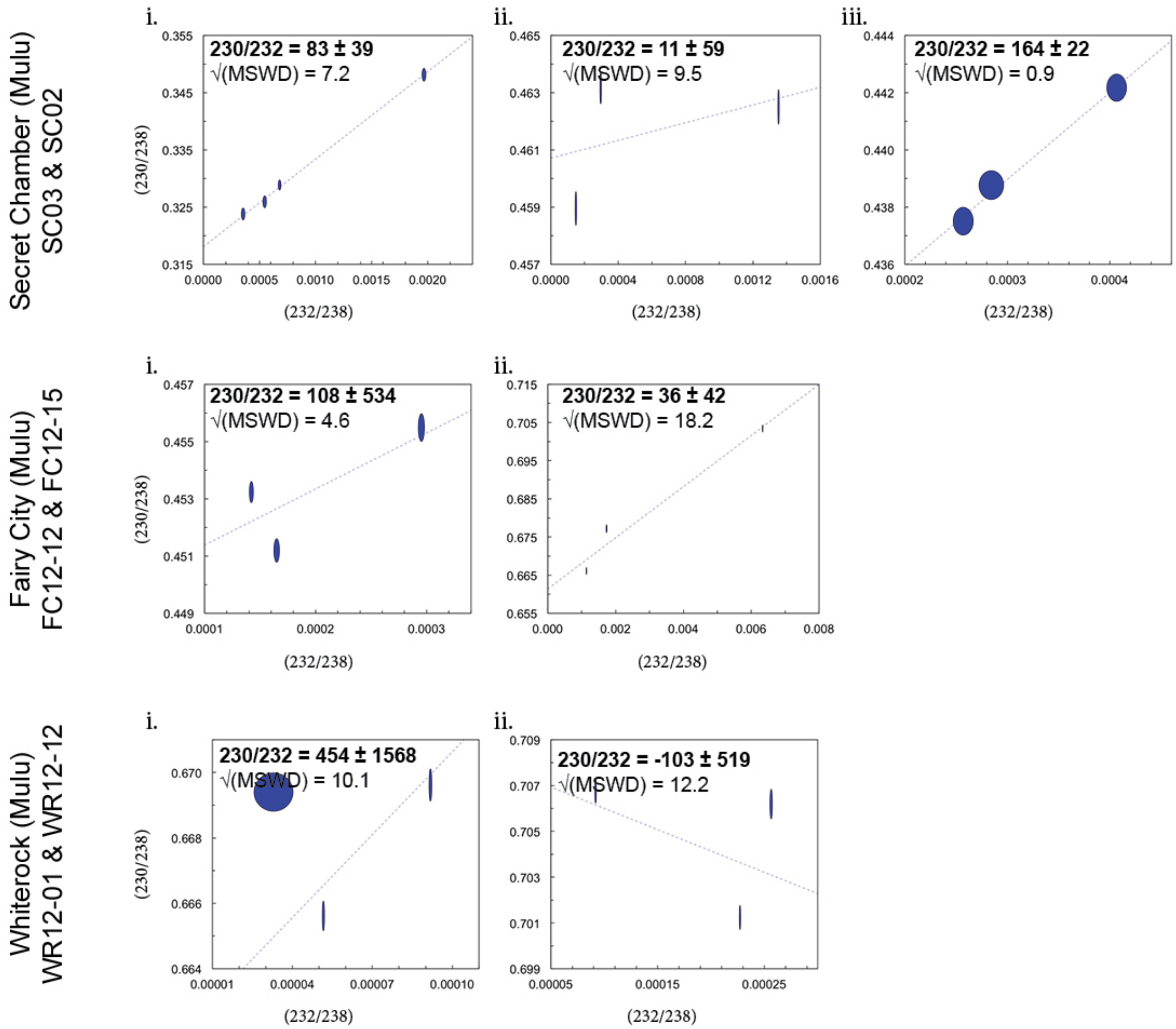


Figure S10. (^{230}Th/^{238}U) v. (^{232}Th/^{238}U) Osmond Type-II isochron diagrams for each sampling spot, with best line of fit and analytical elliptical error bars shown. Isochron's calculated (^{230}Th/^{232}Th)$_{init}$ value and the square √(MSWD), computed using ISOPLOT 3.72 (Ludwig, 1991), is listed in each scatter plot. Isochron diagrams organized by cave chamber.

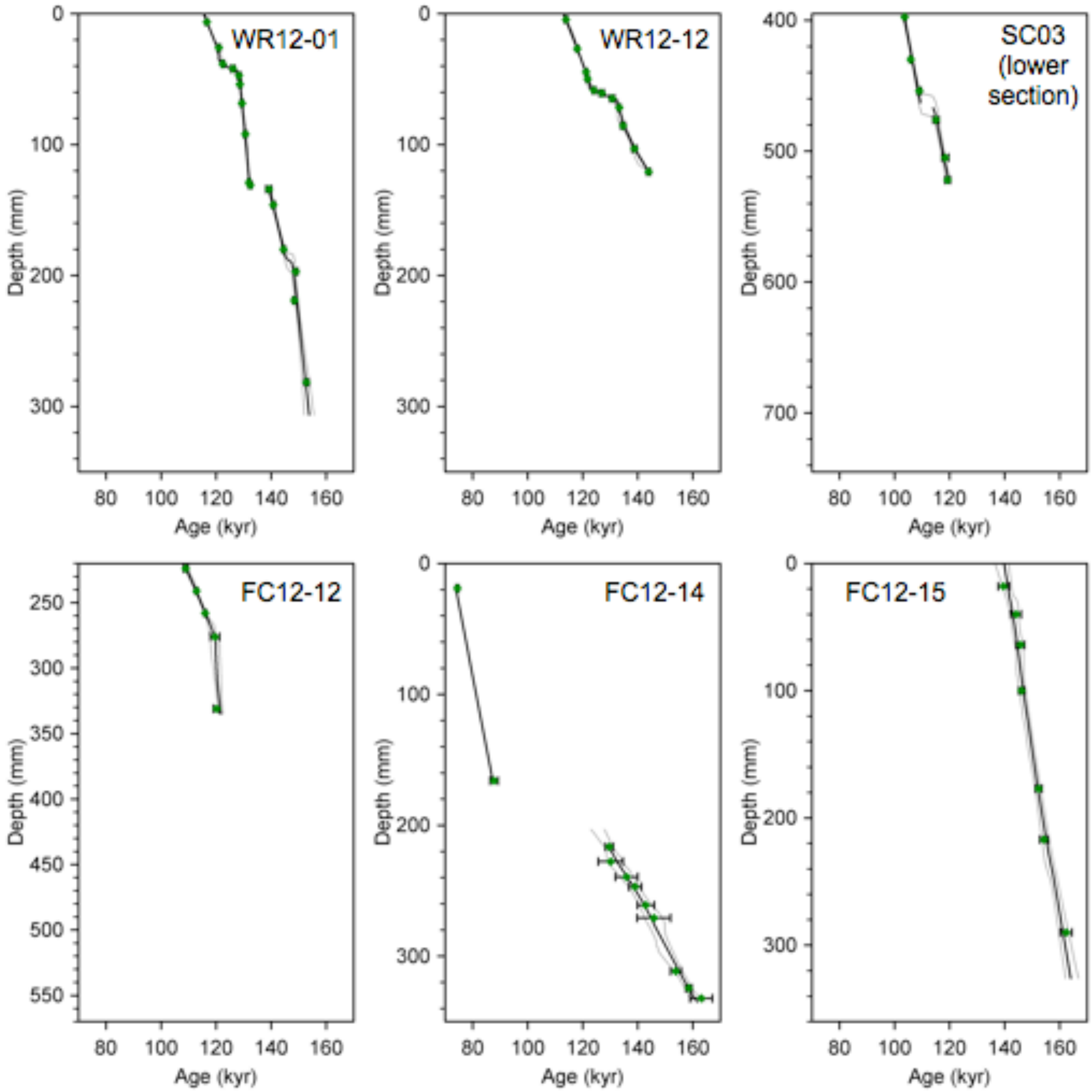


Figure S11. Summary of age-depth plots, provided in Figures S2 through S8, on same-scale age and depth axis.

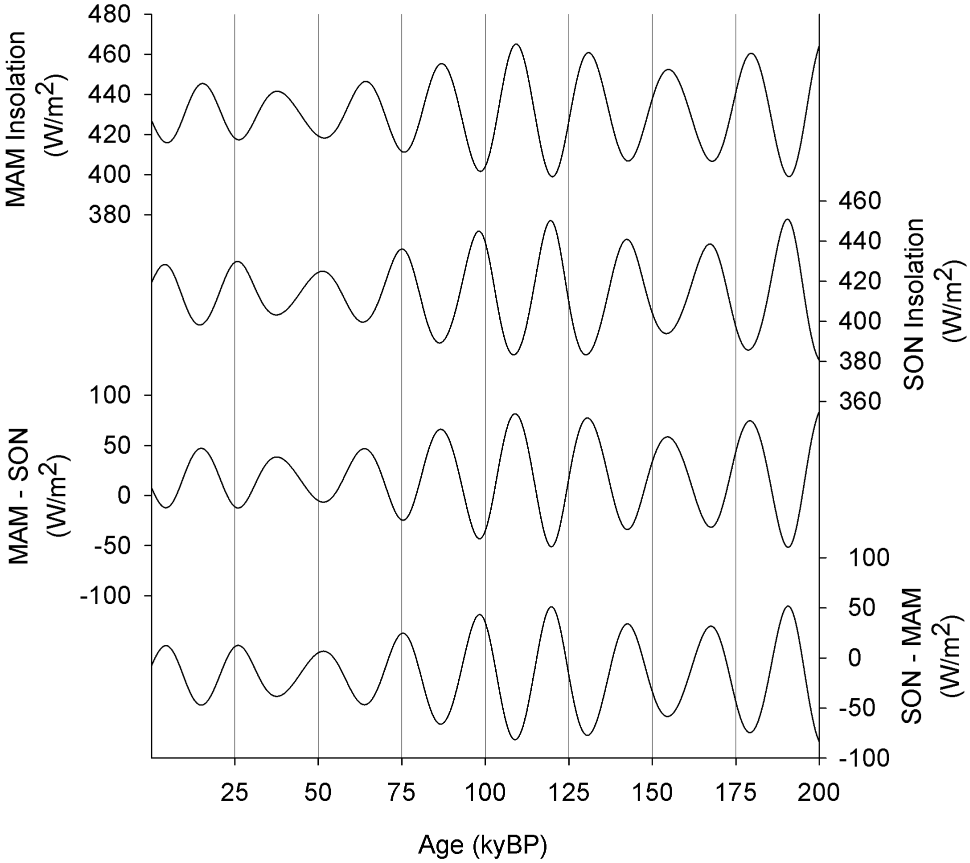


Figure S12. Seasonal insolation at 4°N latitude (Berger, 1978). MAM is average insolation March 1 through May 31. SON is average insolation September 1 through November 31.

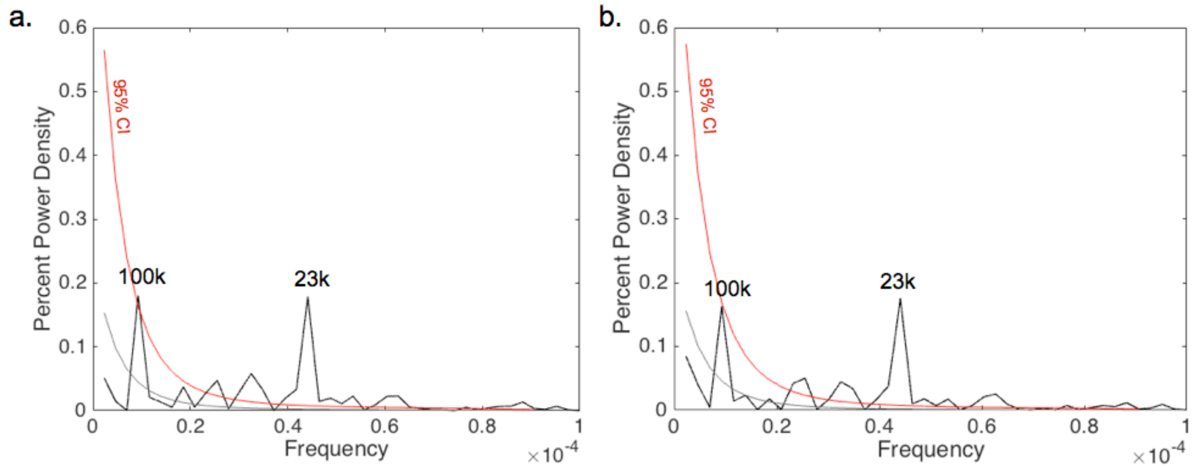


Figure S13. Spectral analysis of the ice-volume corrected 0-429 kyBP Mulu stalagmite $\delta^{18}O$ record, with the 160-210kyBP gap filled (a) with a drawn-in curve that reflects other similar parts of the record and (b) with a simple linear interpolation.

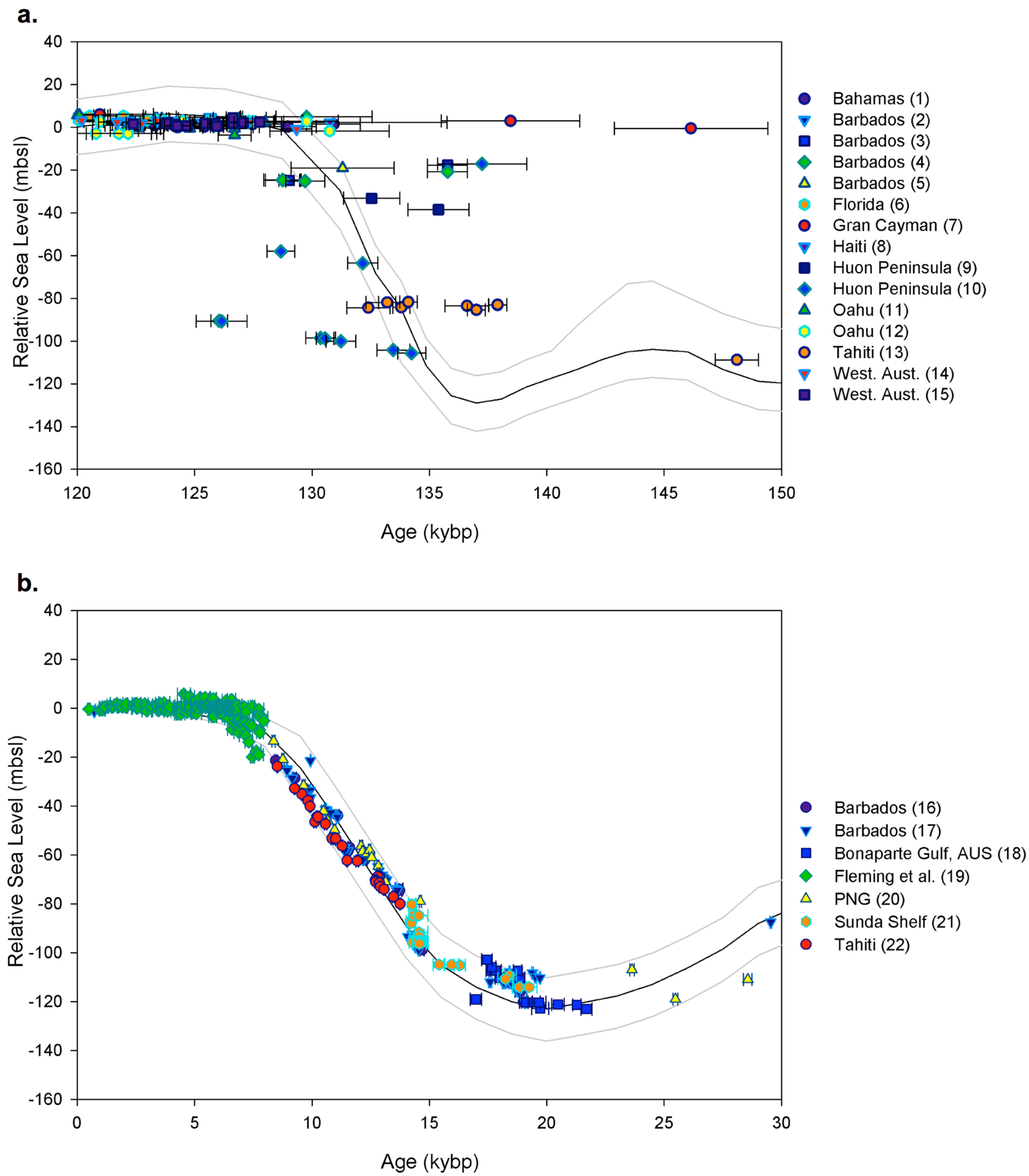


Figure S14. Coral sea level record compared to benthic $\delta^{18}O$ record spanning (a) Termination 2 and (b) Termination 1. (black line) Global mean sea level, calculated from temperature-corrected benthic $\delta^{18}O$ record used for ice-volume corrections in Mulu record with (grey) 95% error markers (Scatter points) Sea level records. Coral ages with $\delta^{234}U < 135.7‰$ and $\delta^{234}U > 155.7‰$ are removed. Citations: (1) Chen et al., 1991; (2) Bard et al., 1990; (3) Gallup et al., 2002; (4) Speed and Cheng, 2004; (5) Thompson and Goldstein, 2005; (6) Muhs et al., 2011; (7) Coyne et al., 2006; (8) Dodge et al., 1983; (9) Stein et al., 1993; (10) Esat et al., 1999; (11) Muhs et al., 2002; (12) Szabo et al., 1994; (13) Thomas et al., 2009; (14) Stirling et al., 1998; (15) Stirling et al., 1995; (16) Fairbanks, 1989; (17) Peltier and Fairbanks, 2006 with A. palmata plotted only; (18) Yokoyama et al., 2000; (19) Fleming et al., 1998; (20) Edwards et al., 1993 and Cutler et al., 2003; (21) Hanebuth et al., 2000; (22) Bard et al., 1996.

Table S1. Original U-Series calculated ages used in this study. Shading indicates isochrons. (*) indicates ages included in final age model. Ages are listed as years before 1950.

Stal	sample	Distance mm	U238 conc ppb	U238 conc error	232Th pmol/g	232Th error	d234U(T) ‰	d234U(T) error ‰	230Th/238U activity	230Th/238U activity error	232Th/238U activity	232Th/238U activity error	Uncorr	Monte Carlo Cor Age (years)	Error Minus	Error Plus		init d234U
SC03	ck10	381.5	119.3	0.1	0.28	0.01	-87.1	0.6	0.5432	6.54E-04	1.78E-04	5.21E-06	100544	100091	530	521	*	-115.5
SC03	ct02	397.5	130.0	0.1	0.40	0.02	-101.7	0.7	0.5446	4.75E-04	2.34E-04	8.87E-06	104237	103627	498	500	*	-136.2
SC03	cl10	430	147.9	0.1	0.11	0.02	-115.2	0.7	0.5404	5.70E-04	5.48E-05	1.01E-05	106018	105872	522	502	*	-155.3
SC03	ct03	454	143.5	0.1	0.84	0.02	-127.3	0.7	0.5434	5.38E-04	4.44E-04	8.73E-06	110130	108917	683	694	*	-173.2
SC03	cs01	476	102.7	0.1	0.31	0.01	-95.1	1.3	0.5823	9.22E-04	2.26E-04	6.83E-06	115595	115010	1007	1038	*	-131.6
SC03	cs02	505	88.5	0.1	0.14	0.01	-93.5	1.6	0.5917	1.11E-03	1.18E-04	8.41E-06	118619	118316	1196	1265	*	-130.6
SC03	cs03	522	122.3	0.1	0.18	0.01	-91.0	1.2	0.5960	8.26E-04	1.11E-04	5.98E-06	119510	119223	935	921		-127.4
SC03	ct04	533.5	127.2	0.1	0.09	0.02	-85.1	0.8	0.5956	6.20E-04	5.59E-05	1.07E-05	117672	117530	620	628		-118.6
SC03	cs04	541	109.4	0.1	0.21	0.01	-76.9	1.3	0.6368	9.69E-04	1.49E-04	6.57E-06	131050	130673	1206	1169		-111.2
SC03	ct05	556.5	101.3	0.1	0.05	0.01	-80.4	0.8	0.6077	5.89E-04	3.79E-05	1.02E-05	120835	120739	629	632		-113.1
SC03	cr05	576	107.6	0.1	0.05	0.01	-93.7	1.4	0.5974	1.36E-03	3.77E-05	7.93E-06	120812	120715	1283	1334		-131.7
SC03	cr01	594	95.2	0.1	0.03	0.01	-71.6	1.4	0.6232	1.61E-03	2.53E-05	9.89E-06	124045	123982	1447	1535		-101.6
SC03	cl18	642.5	90.3	0.1	0.08	0.02	-51.4	0.9	0.6432	6.84E-04	6.32E-05	1.77E-05	125564	125410	728	724		-73.2
FC12-14	co13	19	190.7	0.1	1.25	0.08	-124.7	0.7	0.4303	3.46E-04	4.97E-04	3.12E-05	75267	74337	581	562	*	-153.9
FC12-14	cp18	166	70.9	0.1	1.19	0.02	-146.4	0.9	0.4708	7.86E-04	1.27E-03	2.18E-05	90209	87714	1476	1437	*	-187.5
FC12-14	cs21	207	54.3	0.1	1.69	0.01	-73.2	3.1	0.6526	1.98E-03	2.36E-03	1.67E-05	136379	132135	3537	3677		-106.2
FC12-14	cp19	216.5	64.1	0.1	0.29	0.03	-111.0	1.3	0.6071	1.27E-03	3.48E-04	3.33E-05	130241	129585	1455	1466	*	-160.0
FC12-14	cx01	227.75	51.2	0.1	2.48	0.00	-88.2	3.2	0.6414	1.02E-03	3.68E-03	6.35E-06	136973	130104	4624	4374	*	-127.3
FC12-14	cx02	239.5	51.4	0.1	2.06	0.00	-111.7	2.7	0.6319	1.33E-03	3.05E-03	7.19E-06	141766	135858	4112	4031	*	-163.9
FC12-14	ct08	247	57.5	0.1	1.27	0.01	-142.9	1.2	0.6062	8.14E-04	1.68E-03	1.71E-05	142342	138928	2298	2265	*	-211.5
FC12-14	ct09	261	58.6	0.1	1.79	0.01	-146.3	1.3	0.6133	9.45E-04	2.32E-03	1.91E-05	147620	142835	3079	3043	*	-218.9
FC12-14	cs22	270.75	36.6	0.1	1.44	0.01	-106.5	4.6	0.6560	2.80E-03	2.99E-03	2.41E-05	151556	145788	5833	6281	*	-160.7
FC12-14	ct10	275.5	44.0	0.1	4.15	0.01	-95.5	1.6	0.7019	1.09E-03	7.16E-03	2.40E-05	171999	157800	8745	8083		-149.1
FC12-14	cx03	294.5	53.4	0.0	1.65	0.00	-113.5	0.6	0.6642	6.59E-04	2.35E-03	5.62E-06	159597	155001	2730	2652		-175.8
FC12-14	ct11	311.5	82.9	0.1	1.50	0.01	-141.3	0.8	0.6337	6.70E-04	1.37E-03	1.20E-05	156600	153792	2005	1901	*	-218.0
FC12-14	cx05	324.5	86.5	0.0	0.80	0.00	-131.7	0.5	0.6480	6.04E-04	6.98E-04	3.90E-06	159879	158483	1161	1142	*	-206.0
FC12-14	cn19	332.25	79.3	0.2	1.26	0.02	-165.9	2.4	0.6252	1.58E-03	1.21E-03	1.95E-05	165631	163008	3900	4187	*	-262.8
FC12-12	co07	14.8	368.0	0.2	2.94	0.08	-349.3	0.4	0.2443	1.59E-04	6.07E-04	1.74E-05	53981	52358	879	881		-404.9
FC12-12	cs14		329.2	0.2	2.34	0.01	-392.4	0.6	0.2687	3.20E-04	5.40E-04	2.69E-06	69261	67625	950	923		-474.9
FC12-12	cp01	124.9	294.7	0.1	0.79	0.02	-330.1	0.3	0.3430	2.61E-04	2.03E-04	5.07E-06	85157	84603	392	387		-419.2
FC12-12	cp20	153.8	183.4	0.1	0.96	0.02	-319.1	0.4	0.3948	3.77E-04	3.98E-04	8.57E-06	105350	104247	770	743		-428.2
FC12-12	cu14	223.8	277.3	0.2	1.60	0.00	-282.5	0.6	0.4304	3.33E-04	4.38E-04	9.04E-07	110016	108888	817	810	*	-384.2
FC12-12	cx10	240.8	196.3	0.1	0.66	0.00	-294.5	0.2	0.4285	2.84E-04	2.55E-04	1.28E-06	113498	112819	504	490	*	-405.0
FC12-12	cx06	258.3	134.6	0.1	0.29	0.00	-271.7	0.3	0.4512	3.38E-04	1.65E-04	2.07E-06	116374	115956	461	475	*	-376.8
FC12-12	cx07	258.3	225.2	0.1	0.42	0.00	-268.7	0.2	0.4532	3.02E-04	1.42E-04	1.46E-06	116274	115915	397	400		-372.7
FC12-12	cx09	258.3	142.4	0.1	0.55	0.00	-268.2	0.3	0.4555	3.99E-04	2.96E-04	2.22E-06	117235	116488	619	607		-372.6
FC12-12	cu15	275.8	104.3	0.2	0.55	0.00	-249.6	1.7	0.4762	8.38E-04	3.97E-04	2.67E-06	120482	119514	1658	1695	*	-349.7
FC12-12	cu16	330.8	142.6	0.2	0.10	0.00	-231.6	1.3	0.4895	6.32E-04	5.44E-05	1.74E-06	120236	120108	1155	1181	*	-325.1
FC12-12	cn15	380.8	92.5	0.1	0.24	0.02	-217.0	1.6	0.5111	9.68E-04	1.95E-04	1.30E-05	125272	124827	1603	1615	*	-308.7

*Sample ID identifies Multi-Collector ICP-MS batch (2 letters) and sample run order within batch (1-24)
*All activity ratios and ages are calculated using the U-series half-lives provided in Cheng et al., 2013
*2σ errors are Monte Carlo derived, with the following initial 230/232 ratios: SCH02 = 59 ± 13 ppm; BA02 = 56 ± 11 ppm; SC03 and SC02 = 111 ± 41 ppm; FC12 all = 78 ± 42 ppm; WR12 all = 60 ± 20 ppm

Stal	sample	Distance mm	U238 conc ppb	U238 conc error	232Th pmol/g	232Th error	d234U(T) ‰	d234U(T) error ‰	230Th/238U activity	230Th/238U activity error	232Th/238U activity	232Th/238U activity error	Uncorr	Monte Carlo Cor Age (years)	Error Minus	Error Plus		init d234U
FC12-15	co04		71.8	0.1	0.22	0.09	-80.8	1.7	0.6365	9.54E-04	2.37E-04	9.11E-05	132250	131826	1459	1466		-117.2
FC12-15	cp12		64.0	0.1	0.27	0.03	-50.0	1.3	0.6632	1.28E-03	3.20E-04	3.44E-05	132845	132298	1355	1388		-72.6
FC12-15	cp09	18	54.7	0.1	0.36	0.03	-118.3	1.6	0.6236	1.43E-03	5.01E-04	3.68E-05	140536	139573	1987	2018	*	-175.5
FC12-15	cx11	40	48.7	0.0	1.03	0.00	-123.8	0.6	0.6325	6.06E-04	1.61E-03	4.90E-06	147303	144140	1908	1847	*	-185.9
FC12-15	cx13	64	41.7	0.0	0.63	0.00	-86.7	0.7	0.6660	7.82E-04	1.14E-03	6.61E-06	147784	145699	1492	1505	*	-130.7
FC12-15	cx14	64	46.6	0.0	1.07	0.01	-76.2	0.8	0.6771	8.53E-04	1.73E-03	8.25E-06	148694	145557	2014	2022		-114.9
FC12-15	cx15	64	49.3	0.0	4.11	0.01	-95.0	0.6	0.7036	7.86E-04	6.33E-03	7.88E-06	172748	160298	7279	7090		-149.4
FC12-15	cx17	99.5	59.8	0.0	0.44	0.00	-127.9	0.6	0.6287	6.24E-04	5.61E-04	5.00E-06	147205	146103	1042	1060	*	-193.2
FC12-15	cx18	176.5	50.1	0.0	0.41	0.00	-129.4	0.5	0.6391	8.13E-04	6.23E-04	4.66E-06	153531	152298	1196	1231	*	-198.9
FC12-15	cx19	217	52.3	0.0	0.66	0.00	-166.2	0.5	0.6104	6.50E-04	9.60E-04	5.53E-06	156270	154212	1475	1509	*	-256.9
FC12-15	cp07	289.8	68.1	0.1	0.17	0.03	-175.8	1.1	0.6117	1.13E-03	1.88E-04	2.98E-05	162728	162315	2000	2078	*	-277.9
FC12-15	cp06		66.1	0.1	1.23	0.03	-184.3	1.1	0.6229	1.19E-03	1.41E-03	3.12E-05	176872	173627	3080	3214		-300.9
FC12-15	cn18		81.5	0.2	0.45	0.02	-131.9	2.3	0.6708	1.58E-03	4.17E-04	1.82E-05	174659	173817	3701	3964		-215.5
WR12-01	co11	6.4	491.1	0.2	0.98	0.08	-33.7	0.5	0.6320	2.74E-04	1.51E-04	1.23E-05	116762	116570	466	463	*	-46.8
WR12-01	cp08	26	230.6	0.1	1.32	0.03	-29.2	0.5	0.6492	5.80E-04	4.36E-04	8.76E-06	121459	120907	640	622	*	-41.1
WR12-01	cy01	38.3	523.5	0.2	4.12	0.00	-17.1	0.4	0.6634	3.25E-04	5.98E-04	2.83E-07	123116	122370	551	555	*	-24.2
WR12-01	cs18	42	483.1	0.2	7.87	0.01	-26.5	0.4	0.6685	4.47E-04	1.24E-03	1.70E-06	127589	126019	772	763	*	-37.9
WR12-01	cs19	47.3	379.0	0.2	1.63	0.01	-31.2	0.6	0.6678	5.56E-04	3.27E-04	2.25E-06	128684	128269	670	671	*	-44.8
WR12-01	cp04	54	336.6	0.1	0.15	0.03	-29.0	0.4	0.6694	4.80E-04	3.30E-05	5.96E-06	128645	128604	566	573	*	-41.7
WR12-01	cy03	54	372.1	0.2	0.45	0.00	-29.3	0.4	0.6696	4.07E-04	9.20E-05	3.98E-07	128799	128682	550	554		-42.1
WR12-01	cy05	54	421.0	0.3	0.29	0.00	-30.2	0.5	0.6656	3.70E-04	5.17E-05	3.15E-07	127597	127532	558	567		-43.3
WR12-01	ct13	68.5	343.0	0.1	0.48	0.02	-29.4	0.4	0.6712	4.39E-04	1.06E-04	3.41E-06	129445	129311	540	561	*	-42.4
WR12-01	cs17	90	363.7	0.2	0.15	0.01	-34.3	0.6	0.6781	5.43E-04	3.17E-05	2.21E-06	133595	-60	688	704		-34.3
WR12-01	ct14	92	362.6	0.1	1.20	0.02	-27.9	0.4	0.6763	4.26E-04	2.51E-04	3.23E-06	130884	130566	566	574	*	-40.3
WR12-01	ct15	129	386.3	0.1	0.30	0.02	-20.7	0.3	0.6851	4.19E-04	5.96E-05	3.16E-06	131958	131883	538	545	*	-30.0
WR12-01	cp03	131	389.5	0.2	0.38	0.03	-20.4	0.3	0.6865	4.63E-04	7.40E-05	5.30E-06	132430	132338	576	562	*	-29.6
WR12-01	cs16	134	265.3	0.2	3.19	0.01	-13.2	0.8	0.7125	6.72E-04	9.12E-04	3.03E-06	140222	139088	944	971	*	-19.5
WR12-01	cy02	146	250.1	0.1	0.17	0.00	-13.3	0.4	0.7138	4.78E-04	5.10E-05	4.43E-07	140798	140735	627	634	*	-19.8
WR12-01	cy06	180	333.6	0.2	0.30	0.00	-5.2	0.4	0.7299	4.22E-04	6.82E-05	4.26E-07	144531	144447	631	633	*	-7.8
WR12-01	cp15	197	258.7	0.1	2.27	0.02	-10.3	0.4	0.7376	4.25E-04	6.67E-04	6.61E-06	149714	148889	701	706	*	-15.7
WR12-01	cy07	219	287.1	0.1	0.39	0.00	-3.8	0.4	0.7406	3.77E-04	1.02E-04	3.21E-07	148516	148392	628	625	*	-5.8
WR12-01	cn10	281.5	319.6	0.2	0.23	0.01	-6.9	0.6	0.7479	4.97E-04	5.39E-05	3.49E-06	152906	152840	828	826	*	-10.6
WR12-12	cs06	4.5	383.9	0.2	0.72	0.01	-40.0	0.6	0.6189	6.02E-04	1.43E-04	2.40E-06	113997	113813	589	588	*	-55.2
WR12-12	cu11	26.75	421.4	0.2	0.36	0.00	-30.3	0.5	0.6382	3.59E-04	6.40E-05	5.81E-07	118012	117931	517	506	*	-42.3
WR12-12	ct21	44.5	370.7	0.1	0.18	0.02	-30.0	0.4	0.6478	4.09E-04	3.60E-05	3.55E-06	121173	121128	499	493	*	-42.2
WR12-12	cu10	50	365.1	0.2	0.11	0.00	-30.7	0.6	0.6488	4.31E-04	2.34E-05	7.45E-07	121711	121681	588	574	*	-43.3
WR12-12	cu09	58.5	435.4	0.2	3.51	0.00	-32.6	0.5	0.6558	3.91E-04	6.11E-04	6.58E-07	124732	123952	609	616	*	-46.3
WR12-12	cy09	60.75	391.8	0.2	7.32	0.00	-34.3	0.4	0.6653	3.14E-04	1.42E-03	5.53E-07	128703	126879	807	791	*	-49.0
WR12-12	cu07	64.75	254.0	0.2	3.70	0.00	-14.9	0.8	0.6899	5.13E-04	1.11E-03	1.13E-06	131999	130618	850	874	*	-21.6
WR12-12	ct22	71.75	272.0	0.1	0.48	0.02	-7.3	0.4	0.6997	4.04E-04	1.34E-04	4.56E-06	133332	133167	566	561	*	-10.7
WR12-12	cu13	85.75	238.0	0.2	0.80	0.00	-4.6	0.8	0.7062	5.36E-04	2.55E-04	9.82E-07	134906	134594	757	799	*	-6.7
WR12-12	cy10	85.75	301.4	0.2	0.33	0.00	-3.6	0.4	0.7067	4.48E-04	8.37E-05	5.31E-07	134821	134719	578	592		-5.2
WR12-12	cy11	85.75	271.4	0.2	0.80	0.00	-7.0	0.4	0.7012	4.37E-04	2.25E-04	5.42E-07	133789	133514	600	585		-10.2
WR12-12	cs07	103.25	252.5	0.2	0.54	0.01	-2.6	0.7	0.7182	6.95E-04	1.62E-04	3.26E-06	138890	138693	838	856	*	-3.9
WR12-12	cy13	120.75	238.8	0.2	0.61	0.00	-1.7	0.5	0.7318	4.66E-04	1.93E-04	6.46E-07	144079	143845	687	666	*	-2.6

*Sample ID identifies Multi-Collector ICP-MS batch (2 letters) and sample run order within batch (1-24)

*All activity ratios and ages are calculated using the U-series half-lives provided in Cheng et al., 2013

*2σ errors are Monte Carlo derived, with the following initial 230/232 ratios: SCH02 = 59 ± 13 ppm; BA02 = 56 ± 11 ppm; SC03 and SC02 = 111 ± 41 ppm; FC12 all = 78 ± 42 ppm; WR12 all = 60 ± 20 ppm

Table S2. Osmond-type activity ratios, age, MSWD, and 230/232 atomic ratio for each isochron, organized by cave or stalagmite. Atomic ratios plotted in Figure S3. (Partin et al., 2007; Carolin et al., 2013; this study)

Cave	Stal ID	Isochron No.	Batch ID	(232/238)$_A$	2σ error (rel)	(230/238)$_A$	2σ error (rel)	(234/238)$_A$	2σ error (rel)	Age	Age error	MSWD	230/232 atomic rat	2σ error
Bukat Assam	BA04	Iso-1	sc02	5.21E-03	0.1%	0.065	0.62%	0.388	0.08%	3.6	4.5	418	**50**	**9**
	BA04		sc03	5.77E-03	0.1%	0.063	0.52%	0.388	0.07%					
	BA04		sc04	1.17E-02	0.1%	0.124	0.26%	0.399	0.06%					
	BA04		sc05	1.32E-02	0.1%	0.130	0.37%	0.400	0.05%					
	BA04	Iso-2	sd06	3.38E-04	0.0%	0.061	0.22%	0.404	0.20%	16.5	3.7	325	**86**	**65**
	BA04		sd07	7.66E-04	0.0%	0.065	0.25%	0.405	0.22%					
	BA04		sd08	1.01E-03	0.0%	0.072	0.22%	0.406	0.21%					
	BA04	Iso-3	sc09	1.10E-02	0.1%	0.184	0.13%	0.426	0.04%	20.6	0.5	43	**57**	**1**
	BA04		sc10	6.18E-04	0.1%	0.072	0.30%	0.406	0.05%					
	BA04		sc11	1.39E-04	0.2%	0.069	0.32%	0.405	0.06%					
	BA04		sc12	1.91E-04	0.2%	0.070	0.39%	0.405	0.05%					
	BA04	Iso-4	sg20	6.92E-04	0.1%	0.037	0.19%	0.389	0.04%	9.2	0.3	43	**45**	**8**
	BA04		sg23	2.51E-04	0.3%	0.033	0.21%	0.388	0.04%					
	BA04		sg36	3.59E-04	0.2%	0.034	0.19%	0.387	0.04%					
	BA04		sg15	8.89E-04	0.1%	0.038	0.23%	0.389	0.04%					
	BA02	Iso-5	cg03	1.35E-04	1.5%	0.097	3.63%	0.425	0.06%	28.9	4.1	6	**81**	**92**
	BA02		cg20	2.24E-04	1.0%	0.097	4.12%	0.425	0.06%					
	BA02		cg21	6.02E-04	0.4%	0.102	3.62%	0.424	0.06%					
	BA02		cg09	1.16E-03	0.6%	0.112	3.45%	0.425	0.07%					
	BA02	Iso-6	ch10	4.61E-05	2.6%	0.062	1.23%	0.413	0.04%	17.3	7.9	868	**200**	**459**
	BA02		ch18	6.94E-05	1.8%	0.061	1.34%	0.406	0.04%					
	BA02		ch16	2.02E-04	0.6%	0.063	1.31%	0.405	0.03%					
	BA02		ch03	5.81E-04	0.3%	0.081	1.15%	0.407	0.29%					
Snail Shell	SCH02	Iso-1	se17	1.80E-04	0.4%	0.088	0.14%	0.661	0.03%	15.2	0.3	59	**67**	**10**
	SCH02		se18	1.24E-04	0.5%	0.086	0.12%	0.661	0.03%					
	SCH02		se19	1.40E-03	0.1%	0.103	0.11%	0.662	0.04%					
	SCH02	Iso-2	se20	7.18E-04	0.1%	0.079	0.18%	0.650	0.04%	12.5	1.7	418	**65**	**97**
	SCH02		se21	3.05E-04	0.2%	0.074	0.14%	0.652	0.03%					
	SCH02		se22	4.29E-04	0.2%	0.075	0.14%	0.656	0.04%					
	SCH02	Iso-3	se23	1.13E-03	0.0%	0.091	0.10%	0.645	0.03%	14.6	2.0	1218	**59**	**59**
	SCH02		se24	3.38E-04	0.1%	0.083	0.10%	0.644	0.03%					
	SCH02		se25	8.87E-04	0.1%	0.092	0.09%	0.645	0.04%					
	SCH02	Iso-4	ca05	2.42E-03	0.1%	0.286	0.11%	0.699	0.03%	54.3	0.7	20	**46**	**10**
	SCH02		ca22	4.05E-04	0.5%	0.270	0.12%	0.699	0.03%					
	SCH02		ca04	1.53E-04	1.1%	0.267	0.12%	0.698	0.03%					
	SCH02	Iso-5	ch15	1.47E-03	0.2%	0.222	0.86%	0.690	0.04%	37.1	6.8	62	**84**	**50**
	SCH02		ch06	2.21E-03	0.2%	0.226	0.92%	0.689	0.04%					
	SCH02		ch19	4.44E-03	0.2%	0.273	0.75%	0.686	0.39%					
	SCH02		ch02	3.76E-03	0.1%	0.240	0.95%	0.689	0.05%					

Cave	Stal ID	Isochron No.	Batch ID	$(232/238)_A$	2σ error (rel)	$(230/238)_A$	2σ error (rel)	$(234/238)_A$	2σ error (rel)	Age	Age error	MSWD	230/232 atomic rat	2σ error
Snail Shell	SSC01	Iso-1	sf01	2.29E-04	2.1%	0.152	6.69%	0.882	0.20%	19.9	2.3	0	**135**	**459**
	SSC01		sf02	1.40E-04	2.7%	0.153	5.17%	0.881	0.17%					
	SSC01		sf03	1.41E-04	2.2%	0.149	4.24%	0.881	0.14%					
	SSC01		sf04	2.25E-04	1.4%	0.153	4.39%	0.881	0.15%					
	SSC01	Iso-2	sf16	1.99E-04	16.0%	0.104	0.58%	0.886	0.06%	12.7	0.3	13	**140**	**5**
	SSC01		sf17	2.08E-04	12.2%	0.104	0.47%	0.887	0.04%					
	SSC01		sf22	3.22E-04	10.7%	0.105	0.63%	0.887	0.06%					
	SSC01		sf23	7.21E-04	3.8%	0.113	0.46%	0.888	0.05%					
	SSC01		si20	2.57E-03	0.2%	0.164	0.11%	0.892	0.06%					
	SSC01	Iso-3	sf24	1.88E-03	1.4%	0.074	0.69%	0.916	0.05%	5.5	0.4	37	**84**	**21**
	SSC01		s25	3.99E-04	5.4%	0.054	0.76%	0.917	0.04%					
	SSC01		sf26	3.05E-04	5.6%	0.050	0.65%	0.914	0.14%					
	SSC01		sf27	2.63E-04	6.5%	0.048	0.70%	0.914	0.13%					
	SSC01	Iso-4	si23	1.51E-04	4.7%	0.120	0.19%	0.884	0.05%	15.7	0.5	23	**92**	**108**
	SSC01		s09	2.25E-04	2.2%	0.122	0.16%	0.888	0.05%					
	SSC01		s17	1.66E-04	4.0%	0.121	0.22%	0.888	0.05%					
	SSC01		s13	1.06E-04	7.9%	0.120	0.25%	0.883	0.06%					
Secret	SC03	Iso-1	cc15	3.56E-04	3.6%	0.324	0.26%	0.894	0.06%	48.7	1.5	52	**83**	**39**
	SC03		cc06	5.48E-04	2.3%	0.326	0.26%	0.890	0.07%					
	SC03		cc08	6.81E-04	1.5%	0.329	0.22%	0.893	0.14%					
	SC03		cc04	1.96E-03	0.7%	0.348	0.26%	0.904	0.07%					
	SC03	Iso-2	cc15	1.49E-04	2.2%	0.459	0.11%	0.889	0.05%	80.9	2.6	91	**11**	**59**
	SC03		cc06	1.35E-03	0.3%	0.462	0.11%	0.889	0.05%					
	SC03		cc08	2.96E-04	1.1%	0.463	0.10%	0.891	0.06%					
	SC02	Iso-3	cc15	2.77E-04	2.9%	0.437	0.09%	0.901	0.06%	71.9	0.4	1	**163**	**22**
	SC02		cc06	3.04E-04	3.2%	0.439	0.09%	0.901	0.07%					
	SC02		cc08	4.27E-04	1.8%	0.442	0.09%	0.903	0.06%					
Fairy City	FC12-12	Iso-1	cx06	1.65E-04	1.3%	0.451	0.07%	0.728	0.04%	115.0	11.0	213	**108**	**534**
	FC12-12		cx07	1.42E-04	1.0%	0.453	0.07%	0.731	0.03%					
	FC12-12		cx09	2.96E-04	0.8%	0.455	0.09%	0.732	0.04%					
	FC12-15	Iso-2	cx13	1.14E-03	0.6%	0.666	0.12%	0.913	0.08%	142.0	18.0	332	**36**	**42**
	FC12-15		cx14	1.73E-03	0.5%	0.677	0.13%	0.924	0.08%					
	FC12-15		cx15	6.33E-03	0.1%	0.703	0.11%	0.905	0.07%					
White Rock	WR12-01	Iso-1	cp04	3.30E-05	18.1%	0.669	0.07%	0.971	0.04%	126.0	9.8	102	**453**	**1565**
	WR12-01		cy03	9.20E-05	0.4%	0.670	0.06%	0.971	0.04%					
	WR12-01		cy05	5.17E-05	0.6%	0.666	0.06%	0.970	0.05%					
	WR12-12	Iso-2	cu13	2.55E-04	0.4%	0.706	0.08%	0.995	0.08%	134.5	8.9	150	**-103**	**518**
	WR12-12		cy10	8.37E-05	0.6%	0.707	0.06%	0.996	0.04%					
	WR12-12		cy11	2.25E-04	0.2%	0.701	0.06%	0.993	0.04%					

Notes:
*Half-lives of ^{234}U and ^{230}Th provided in Cheng et al. (2013).
*Age, MSWD, and 230/232 calculated using ISOPLOT 3.72 (Ludwig, 1993).

Table S3. Weighted and unweighted mean detrital 230/232 atomic ratios and errors determined from isochrons (Partin et al., 2007; Carolin et al., 2013; this study).

Stal ID	Isochron[a]	Age (kyr)	2σ error (kyr)	232/230 (atomic)[b]	2σ error	σ^{-1}	$\Sigma\sigma^{-1}$	Weight[c]	Weighted mean 230/232	2σ error	Unweighted mean 230/232	2σ error
BA02	Line 1	28.9	4.1	**81**	92	0.02	2.0	1%	56	1	87	354
BA02	Line 2	17.3	7.9	**200**	459	0.00		0%				
BA04	Line 1	3.6	4.5	**50**	9	0.23		11%				
BA04	Line 2	16.5	3.7	**86**	65	0.03		2%				
BA04	Line 3	20.6	0.5	**57**	1	1.48		73%				
BA04	Line 4	9.2	0.3	**45**	8	0.26		13%				
SSC01	Line 1	19.9	2.3	**135**	459	0.00	0.5	1%	127	4	113	57
SSC01	Line 2	12.7	0.3	**140**	5	0.37		76%				
SSC01	Line 3	5.5	0.4	**84**	21	0.10		19%				
SSC01	Line 4	15.7	0.5	**92**	108	0.02		4%				
SCH02	Line 1	15.2	0.3	**67**	10	0.20	0.5	39%	59	4	64	28
SCH02	Line 2	12.5	1.7	**65**	97	0.02		4%				
SCH02	Line 3	14.6	2.0	**59**	59	0.03		7%				
SCH02	Line 4	54.3	0.7	**46**	10	0.21		42%				
SCH02	Line 5	37.1	6.8	**84**	50	0.04		8%				
SC02	Line 1	71.9	0.4	**163**	22	0.09	0.2	52%	111	11	86	153
SC03	Line 1	48.7	1.5	**83**	39	0.05		29%				
SC03	Line 2	80.9	2.6	**11**	59	0.03		19%				
FC12-12	Line 1	115.0	11.0	**108**	534	0.00	0.1	7%	41	39	72	101
FC12-15	Line 1	142.0	18.0	**36**	42	0.05		93%				

[a]Individual isochrons, numbered by stalagmite.
[b]Atomic 230/232 calculated using ISOPLOT 3.72 (Ludwig, 1993).
[c]Weights calculated as inverse of 1 standard deviation divided by the total sum

Table S4. Original and corrected $\delta^{18}O$ with mean ocean water variability due to ice volume growth/decay removed (this study). Ages are listed as years before 1950.

SC03 (New high resolution)

FINAL AGE	d18O	Ice-corr d18O
81211	-8.99	-9.15
81315	-9.04	-9.20
81422	-9.16	-9.32
81525	-9.07	-9.23
81629	-9.01	-9.18
81736	-9.00	-9.16
81840	-9.06	-9.22
81944	-8.88	-9.04
82050	-8.91	-9.08
82154	-8.92	-9.09
82258	-8.93	-9.10
82365	-8.82	-8.99
82469	-9.13	-9.31
82521	-9.16	-9.34
82575	-9.10	-9.28
82627	-8.86	-9.04
82679	-8.89	-9.08
82733	-8.86	-9.04
82785	-8.70	-8.89
82838	-8.80	-8.99
82891	-8.86	-9.05
82944	-8.72	-8.91
82996	-8.83	-9.03
83050	-8.77	-8.96
83102	-8.73	-8.93
83154	-8.66	-8.86
83208	-8.62	-8.82
83261	-8.53	-8.74
83313	-8.46	-8.67
83367	-8.51	-8.72
83419	-8.56	-8.77
83471	-8.61	-8.82
83525	-8.66	-8.88
83577	-8.47	-8.69
83630	-8.43	-8.65
83683	-8.34	-8.57
83736	-8.30	-8.53
83788	-8.30	-8.54
83842	-8.45	-8.69
83894	-8.53	-8.76
83946	-8.44	-8.68
84000	-8.34	-8.58
84053	-8.53	-8.78
84143	-8.41	-8.66
84236	-8.32	-8.58
84327	-8.26	-8.52
84418	-8.58	-8.85
84511	-8.62	-8.89
84601	-8.55	-8.83
84692	-8.36	-8.64
84785	-8.49	-8.78
84876	-8.45	-8.75
84966	-8.54	-8.84
85060	-8.58	-8.88
85150	-8.46	-8.77
85241	-8.43	-8.74
85334	-8.52	-8.84
85425	-8.44	-8.77
85515	-8.41	-8.74
85609	-8.45	-8.79
85699	-8.41	-8.75
85790	-8.52	-8.87
85883	-8.53	-8.88
85974	-8.46	-8.82
86064	-8.39	-8.75
86158	-8.53	-8.89
86248	-8.60	-8.97
86339	-8.52	-8.89
86432	-8.59	-8.96
86523	-8.57	-8.95
86613	-8.56	-8.95
86706	-8.64	-9.03
86797	-8.50	-8.89
86888	-8.36	-8.75
86981	-8.55	-8.94
87071	-8.53	-8.93
87162	-8.49	-8.89
87255	-8.55	-8.95
87346	-8.52	-8.93
87436	-8.43	-8.84
87530	-8.53	-8.93
87620	-8.45	-8.86
87711	-8.68	-9.09
87758	-8.52	-8.93
87891	-8.58	-8.99
87979	-8.58	-9.00
88069	-8.49	-8.90
88157	-8.61	-9.02
88245	-8.57	-8.98
88336	-8.51	-8.93
88424	-8.59	-9.00
88511	-8.40	-8.81
88602	-8.53	-8.95
88690	-8.75	-9.16
88778	-9.07	-9.48
88823	-9.07	-9.49
88972	-8.94	-9.35
89070	-8.92	-9.33
89172	-9.07	-9.48
89270	-9.18	-9.59
89368	-9.13	-9.54
89470	-9.03	-9.44
89568	-8.97	-9.38
89666	-8.99	-9.40
89768	-9.03	-9.44
89866	-9.13	-9.54
89964	-8.93	-9.33
90066	-8.89	-9.29
90164	-9.08	-9.48
90262	-9.12	-9.52
90364	-9.09	-9.49
90462	-9.11	-9.50
90560	-9.07	-9.47
90662	-8.97	-9.36
90760	-9.10	-9.49

SC03 (103-119kybp)

FINAL AGE	d18O	Ice-corr d18O
103491	-8.42	-8.64
103581	-8.47	-8.70
103670	-8.30	-8.53
103758	-8.28	-8.51
103845	-8.24	-8.47
103934	-8.39	-8.62
104024	-8.15	-8.39
104114	-8.14	-8.38
104204	-7.93	-8.17
104293	-8.16	-8.41
104382	-7.79	-8.04
104472	-7.99	-8.24
104564	-8.19	-8.44
104657	-7.84	-8.09
104749	-7.89	-8.15
104840	-8.29	-8.54
104931	-8.31	-8.57
105021	-8.15	-8.41
105112	-8.36	-8.63
105202	-8.07	-8.33
105291	-7.81	-8.08
105380	-8.08	-8.35
105470	-8.23	-8.51
105563	-8.00	-8.28
105654	-7.94	-8.22
105743	-8.04	-8.32
105834	-8.08	-8.36
105927	-7.89	-8.18
106019	-8.02	-8.31
106109	-7.97	-8.26
106199	-8.03	-8.32
106290	-7.99	-8.29
106380	-8.26	-8.56
106469	-8.46	-8.76
106558	-8.29	-8.60
106649	-8.54	-8.85
106740	-8.16	-8.47
106831	-8.14	-8.46
106922	-8.32	-8.64
107013	-8.05	-8.37
107103	-8.21	-8.53
107193	-7.90	-8.23
107282	-8.20	-8.54
107372	-8.12	-8.46
107462	-8.28	-8.63
107552	-8.07	-8.41
107640	-8.19	-8.54
107728	-8.21	-8.56
107816	-8.15	-8.50
107906	-8.40	-8.76
107995	-8.32	-8.68
108084	-8.51	-8.88
108172	-8.32	-8.69
108260	-8.32	-8.69
108350	-8.46	-8.83
108441	-8.48	-8.86
108529	-8.46	-8.84
108617	-8.63	-9.01
108715	-8.64	-9.02
108813	-8.50	-8.88
108890	-8.51	-8.90
108973	-8.37	-8.76
109134	-8.58	-8.97
109236	-8.82	-9.21
109247	-8.59	-8.98
109258	-8.75	-9.14
114004	-9.08	-9.25
114126	-8.92	-9.07
114337	-9.03	-9.18
114532	-8.99	-9.13
114668	-9.10	-9.23
114786	-9.10	-9.23
114902	-8.98	-9.11
115005	-9.02	-9.15
115097	-8.81	-8.93
115191	-8.95	-9.07
115289	-9.02	-9.13
115381	-8.87	-8.98
115465	-8.85	-8.96
115551	-8.80	-8.91
115644	-8.86	-8.97
115738	-8.70	-8.80
115832	-8.69	-8.79
115926	-8.90	-9.00
116019	-8.77	-8.87
116114	-8.69	-8.79
116208	-8.64	-8.73
116296	-8.61	-8.70
116382	-8.84	-8.93
116476	-8.68	-8.77
116578	-8.76	-8.84
116676	-8.73	-8.81
116766	-8.56	-8.64
116856	-8.79	-8.86
116947	-8.80	-8.87
117038	-8.65	-8.72
117129	-8.79	-8.85
117223	-8.72	-8.78
117318	-8.70	-8.76
117412	-8.49	-8.54
117503	-8.35	-8.40
117592	-8.36	-8.41
117680	-8.19	-8.23
117771	-8.22	-8.26
117864	-8.04	-8.07
117957	-8.18	-8.21
118050	-8.18	-8.21
118142	-8.30	-8.33
118236	-8.49	-8.51
118333	-8.41	-8.43
118431	-8.49	-8.52
118525	-8.49	-8.51
118617	-8.62	-8.63
118712	-8.57	-8.59
118813	-8.71	-8.73
118911	-8.56	-8.57
119004	-8.34	-8.35
119094	-8.57	-8.58
119182	-8.52	-8.53
119269	-8.46	-8.47
119356	-8.18	-8.19
119447	-8.42	-8.42

SC02 (94-99kybp)

FINAL AGE	d18O	Ice-corr d18O
94082	-9.05	-9.31
94162	-8.93	-9.19
94243	-8.90	-9.15
94323	-9.11	-9.35
94404	-9.20	-9.44
94484	-8.84	-9.08
94565	-9.10	-9.34
94646	-9.01	-9.25
94726	-9.04	-9.28
94807	-9.12	-9.35
94887	-8.93	-9.16
94968	-9.15	-9.38
95048	-8.93	-9.16
95129	-9.06	-9.29
95210	-9.01	-9.24
95290	-9.04	-9.27
95371	-9.08	-9.30
95532	-9.09	-9.31
95612	-8.96	-9.18
95693	-9.03	-9.26
95774	-9.25	-9.48
95854	-9.09	-9.31
95935	-9.29	-9.52
96015	-9.31	-9.54
96096	-9.21	-9.44
96176	-9.26	-9.49
96257	-9.21	-9.44
96338	-9.16	-9.39
96418	-9.18	-9.41
96499	-9.55	-9.79
96579	-9.50	-9.74
96660	-9.21	-9.45
96740	-9.58	-9.82
96821	-9.84	-10.07
96902	-9.58	-9.82
96982	-9.40	-9.64
97063	-9.59	-9.82
97143	-9.63	-9.87
97224	-9.70	-9.94
97304	-9.50	-9.74
97385	-9.56	-9.80
97466	-9.43	-9.67
97546	-9.17	-9.41
97627	-9.26	-9.50
97707	-9.30	-9.54
97788	-9.53	-9.77
97868	-9.49	-9.73
98030	-9.49	-9.72
98110	-9.46	-9.70
98191	-9.81	-10.04
98271	-9.80	-10.03
98352	-9.70	-9.93
98432	-9.75	-9.98
98513	-9.81	-10.04
98594	-9.79	-10.02
98674	-9.75	-9.97
98755	-9.73	-9.95
98835	-9.75	-9.97
98916	-9.37	-9.59

FC12-12

FINAL AGE	d18O	Ice-corr d18O
108943	-8.25	-8.64
109250	-8.35	-8.74
109860	-8.65	-9.04
110171	-8.71	-9.10
110488	-8.64	-9.02
110803	-8.98	-9.36
111114	-8.83	-9.19
111425	-8.80	-9.15
111734	-8.93	-9.25
112038	-8.78	-9.08
112340	-8.57	-8.85
112641	-8.56	-8.82
112939	-8.72	-8.95
113238	-8.84	-9.05
113541	-8.89	-9.08
113844	-8.60	-8.77
114144	-8.88	-9.03
114444	-8.54	-8.68
114741	-8.74	-8.87
115036	-8.34	-8.46
115337	-8.53	-8.64
115639	-8.60	-8.70
115940	-8.41	-8.50
116242	-9.19	-9.29
116540	-8.23	-8.32
116640	-8.20	-8.28
116839	-8.72	-8.79
117038	-8.59	-8.66
117237	-8.47	-8.53
117435	-8.66	-8.71
117631	-8.47	-8.52
117826	-8.30	-8.34
118018	-8.44	-8.48
118201	-8.72	-8.74
118373	-8.82	-8.84
118539	-8.84	-8.86
118705	-9.64	-9.66
118867	-9.46	-9.48
119022	-9.58	-9.59
119185	-9.20	-9.21
119363	-9.07	-9.07
119480	-9.57	-9.57
119548	-9.37	-9.37
119614	-9.40	-9.40
119692	-10.00	-10.00
119778	-9.56	-9.56
119855	-9.32	-9.32
119882	-8.79	-8.79
119884	-9.30	-9.29
119885	-9.12	-9.12
119887	-9.13	-9.13
119889	-9.90	-9.90
119890	-9.28	-9.28
119892	-9.25	-9.25
119893	-9.24	-9.24
119910	-9.80	-9.80
119930	-9.80	-9.80
119953	-9.66	-9.65
119978	-9.18	-9.18
120002	-9.39	-9.39
120022	-9.28	-9.27
120042	-9.53	-9.53
120063	-9.41	-9.41
120084	-9.43	-9.42
120104	-9.85	-9.85
120125	-9.75	-9.74
120150	-10.05	-10.05
120174	-9.80	-9.79
120196	-10.13	-10.12
120217	-9.74	-9.73
120242	-9.96	-9.95
120269	-10.11	-10.10
120293	-9.96	-9.95
120316	-9.84	-9.84
120344	-10.14	-10.13
120396	-9.81	-9.80
120455	-9.51	-9.50
120513	-9.63	-9.62
120560	-9.29	-9.28
120603	-9.85	-9.84
120654	-9.32	-9.31
120708	-9.62	-9.61
120762	-9.31	-9.30
120813	-9.69	-9.68
120860	-9.85	-9.83
120909	-9.59	-9.57
120968	-9.50	-9.49
121029	-9.54	-9.52
121082	-9.29	-9.27
121131	-9.41	-9.40
121179	-9.19	-9.18
121230	-9.56	-9.54
121283	-8.86	-8.84
121338	-8.76	-8.74
121393	-9.23	-9.22
121443	-9.34	-9.33

FC12-15

FINAL AGE	d18O	Ice-corr d18O
139860	-6.77	-7.77
139931	-6.59	-7.59
140002	-6.93	-7.93
140072	-6.85	-7.85
140143	-7.07	-8.06
140214	-7.33	-8.32
140287	-7.50	-8.48
140360	-7.33	-8.31
140434	-7.78	-8.76
140506	-7.45	-8.43
140579	-7.64	-8.62
140651	-7.31	-8.28
140723	-7.41	-8.38
140796	-7.33	-8.30
140870	-7.88	-8.85
140942	-7.74	-8.70
141015	-7.53	-8.50
141089	-7.43	-8.39
141163	-7.52	-8.48
141238	-7.43	-8.39
141314	-7.53	-8.48
141391	-7.91	-8.86
141470	-7.29	-8.23
141551	-7.63	-8.57
141633	-7.54	-8.48
141717	-7.55	-8.49
141804	-7.60	-8.53
141896	-7.68	-8.61
141993	-7.91	-8.84
142093	-8.20	-9.12
142191	-7.79	-8.72
142283	-7.65	-8.57
142371	-7.58	-8.50
142457	-7.92	-8.83
142541	-7.76	-8.68
142620	-7.63	-8.54
142697	-7.72	-8.63
142775	-7.52	-8.42
142856	-7.67	-8.57
143021	-7.55	-8.45
143173	-7.70	-8.60
143332	-7.84	-8.73
143485	-7.80	-8.69
143624	-7.94	-8.83
143755	-7.90	-8.78
143899	-7.81	-8.69
144034	-8.12	-9.00
144159	-7.96	-8.84
144284	-7.71	-8.59
144420	-8.45	-9.32
144544	-8.18	-9.05
144669	-7.83	-8.70
144788	-8.13	-9.00
144913	-7.92	-8.79
145034	-8.06	-8.93
145148	-8.12	-9.00
145260	-8.11	-8.99
145367	-8.02	-8.90
145480	-8.70	-9.59
145592	-8.71	-9.59
145702	-8.98	-9.87
145811	-8.91	-9.80
145929	-8.60	-9.49
146049	-8.68	-9.57
146172	-8.70	-9.60
146297	-8.67	-9.58
146425	-8.39	-9.30
146559	-8.21	-9.12
146694	-8.27	-9.19
146827	-8.41	-9.34
146959	-8.46	-9.39
147093	-8.45	-9.39
147226	-8.59	-9.54
147361	-8.60	-9.55
147497	-8.21	-9.17
147636	-8.29	-9.26
147772	-8.58	-9.55
147913	-8.73	-9.71
148058	-8.90	-9.88
148201	-8.25	-9.23
148341	-8.57	-9.56
148479	-8.46	-9.45
148618	-8.40	-9.40
148753	-8.42	-9.43
149019	-8.37	-9.38
149149	-8.52	-9.53
149284	-8.09	-9.10
149417	-8.48	-9.50
149550	-8.72	-9.74
149684	-8.41	-9.43
149817	-8.27	-9.29
149954	-8.09	-9.11
150092	-7.72	-8.74
150228	-7.97	-8.99
150300	-8.06	-9.08
150442	-7.86	-8.88
150579	-7.66	-8.68
150719	-7.53	-8.55
150858	-7.72	-8.73
151001	-7.71	-8.73
151143	-7.94	-8.96
151282	-7.89	-8.90
151426	-8.08	-9.09
151571	-8.08	-9.09
151861	-7.99	-8.99
152005	-7.97	-8.97
152146	-8.17	-9.18
152293	-8.08	-9.08
152443	-8.33	-9.33
152589	-8.33	-9.32
152737	-7.85	-8.83
152889	-7.65	-8.64
153039	-7.68	-8.66
153185	-7.78	-8.75
153333	-8.17	-9.13
153479	-8.08	-9.04
153626	-8.31	-9.25
153776	-7.83	-8.76
153925	-7.83	-8.75
154076	-7.85	-8.75
154229	-7.86	-8.74
154380	-8.08	-8.95
154528	-8.06	-8.91
154680	-7.91	-8.74
154834	-7.78	-8.59
154984	-7.85	-8.64
155166	-7.96	-8.73
155341	-7.77	-8.52
155491	-7.99	-8.72
155651	-7.93	-8.64
155807	-7.70	-8.40
155970	-7.66	-8.34

Table S5. (cont'd)

WR12-01

FINAL AGE	d18O	Ice-corr d18O
115738	-8.31	-8.42
115775	-8.57	-8.67
115813	-8.55	-8.65
115850	-8.69	-8.79
115887	-8.50	-8.60
115924	-8.53	-8.63
115961	-8.46	-8.56
115997	-8.63	-8.72
116033	-8.63	-8.73
116069	-8.72	-8.82
116105	-8.79	-8.88
116141	-8.33	-8.43
116177	-8.61	-8.70
116213	-8.45	-8.54
116250	-8.43	-8.52
116287	-8.33	-8.42
116323	-8.43	-8.52
116360	-8.45	-8.54
116397	-8.38	-8.47
116434	-8.49	-8.58
116471	-8.28	-8.36
116508	-8.16	-8.24
116545	-8.24	-8.32
116582	-8.29	-8.37
116618	-8.38	-8.46
116655	-8.32	-8.40
116691	-8.33	-8.41
116726	-8.15	-8.23
116762	-8.15	-8.22
116798	-8.15	-8.22
116833	-8.09	-8.17
116869	-8.06	-8.13
116905	-8.28	-8.36
116941	-8.28	-8.34
116977	-8.23	-8.30
117013	-8.20	-8.27
117050	-8.38	-8.45
117087	-8.29	-8.36
117124	-8.34	-8.40
117161	-8.25	-8.31
117198	-8.32	-8.38
117235	-8.41	-8.47
117272	-8.55	-8.61
117310	-8.34	-8.40
117347	-8.33	-8.39
117384	-8.38	-8.44
117421	-8.48	-8.54
117458	-8.52	-8.57
117495	-8.37	-8.42
117532	-8.31	-8.36
117568	-8.33	-8.38
117605	-8.37	-8.42
117642	-8.44	-8.48
117680	-8.49	-8.54
117717	-8.43	-8.48
117754	-8.41	-8.45
117792	-8.41	-8.45
117829	-8.40	-8.43
117867	-8.43	-8.46
117905	-8.36	-8.40
117942	-8.35	-8.39
117980	-8.34	-8.37
118018	-8.48	-8.51
118056	-8.31	-8.35
118094	-8.36	-8.39
118132	-8.44	-8.47
118170	-8.60	-8.63
118208	-8.57	-8.59
118246	-8.51	-8.53
118284	-8.42	-8.44
118322	-8.46	-8.49
118360	-8.40	-8.43
118398	-8.42	-8.45
118436	-8.36	-8.38
118474	-8.54	-8.56
118512	-8.73	-8.75
118551	-8.62	-8.64
118628	-8.54	-8.56
118666	-8.56	-8.58
118705	-8.66	-8.68
118743	-8.54	-8.56
118782	-8.56	-8.57
118820	-8.48	-8.49
118859	-8.43	-8.44
118898	-8.67	-8.68
118937	-8.56	-8.57
118975	-8.52	-8.53
119014	-8.61	-8.62
119053	-8.67	-8.68
119092	-8.61	-8.62
119130	-8.64	-8.65
119169	-8.70	-8.70
119208	-8.87	-8.87
119246	-8.94	-8.94
119285	-9.20	-9.20
119323	-9.12	-9.13
119362	-9.22	-9.22
119400	-9.13	-9.13
119439	-9.15	-9.15
119477	-8.99	-8.99
119515	-8.99	-8.99
119553	-9.03	-9.03
120136	-8.71	-8.71
120171	-8.58	-8.57
120206	-8.75	-8.75
120241	-8.75	-8.74
120277	-8.80	-8.80
120313	-8.70	-8.69
120332	-8.77	-8.76
120351	-8.77	-8.76
120370	-8.84	-8.83
120389	-8.86	-8.85
120409	-8.94	-8.94
120427	-8.84	-8.84
120446	-8.78	-8.77
120464	-8.66	-8.65
120481	-8.69	-8.68
120497	-8.70	-8.69
120513	-8.58	-8.57
120527	-8.65	-8.65
120541	-8.64	-8.63
120555	-8.70	-8.69
120569	-8.61	-8.60
120585	-8.63	-8.62
120602	-8.64	-8.63
120622	-8.62	-8.61
120645	-8.72	-8.71
120672	-8.68	-8.67
120703	-8.69	-8.68
120738	-8.51	-8.50
120776	-8.64	-8.63
120814	-8.63	-8.61
120850	-8.71	-8.70
120882	-8.74	-8.73
120907	-8.72	-8.71
120923	-8.62	-8.60
120928	-8.60	-8.59
120929	-8.57	-8.55
120930	-8.45	-8.44
120931	-8.62	-8.60
120932	-8.60	-8.58
120933	-8.76	-8.75
120934	-8.69	-8.68
120935	-8.68	-8.67
120936	-8.60	-8.58
120937	-8.61	-8.60
120938	-8.59	-8.57
120939	-8.53	-8.52
120940	-8.46	-8.45
120941	-8.41	-8.40
120942	-8.45	-8.44
120973	-8.31	-8.30
121017	-8.33	-8.31
121073	-8.27	-8.26
121138	-8.39	-8.37
121209	-8.43	-8.42
121283	-8.57	-8.56
121359	-8.54	-8.52
121433	-8.64	-8.62
121504	-8.43	-8.41
121601	-8.45	-8.43
121730	-8.49	-8.47
121854	-8.55	-8.53
121976	-8.67	-8.64
122096	-8.59	-8.57
122215	-8.52	-8.49
122335	-8.64	-8.61
122456	-8.61	-8.58
122581	-8.59	-8.56
122711	-8.54	-8.51
122843	-8.48	-8.44
122977	-8.49	-8.45
123112	-8.42	-8.38
123245	-8.34	-8.30
123377	-8.36	-8.31
123506	-8.37	-8.32
123629	-8.62	-8.58
123747	-8.45	-8.40
123857	-8.46	-8.42
123960	-8.41	-8.36
124058	-8.44	-8.39
124156	-8.48	-8.43
124258	-8.45	-8.40
124368	-8.53	-8.47
124490	-8.41	-8.35
124628	-8.40	-8.34
124787	-8.47	-8.41
124971	-8.44	-8.39
125184	-8.35	-8.30
125428	-8.41	-8.36
125697	-8.29	-8.24
125983	-8.31	-8.27
126280	-8.01	-7.98
126578	-8.03	-8.00
126871	-8.13	-8.10
127150	-8.08	-8.06
127408	-7.93	-7.92
127637	-8.00	-7.99
127829	-7.81	-7.80
127978	-7.58	-7.58
128088	-7.51	-7.51
128165	-7.75	-7.75
128209	-7.44	-7.44
128222	-7.40	-7.40
128225	-7.56	-7.56
128226	-7.53	-7.53
128227	-7.44	-7.44
128227	-7.28	-7.29
128228	-7.55	-7.55
128229	-7.39	-7.39
128229	-7.24	-7.24
128236	-7.27	-7.27
128247	-7.20	-7.21
128271	-7.35	-7.36
128296	-7.16	-7.17
128323	-7.26	-7.26
128349	-7.31	-7.31
128373	-7.21	-7.21
128394	-7.15	-7.15
128411	-7.15	-7.15
128424	-7.30	-7.30
128433	-7.34	-7.34
128440	-7.35	-7.35
128444	-7.41	-7.41
128448	-7.52	-7.52
128450	-7.71	-7.71
128452	-7.58	-7.59
128455	-7.57	-7.58
128459	-7.56	-7.57
128464	-7.74	-7.75
128472	-7.90	-7.90
128480	-7.71	-7.72
128490	-7.68	-7.68
128500	-7.80	-7.81
128511	-7.84	-7.85
128523	-7.78	-7.79
128534	-7.58	-7.59
128546	-7.55	-7.56
128557	-7.59	-7.60
128568	-7.55	-7.56
128578	-7.59	-7.59
128588	-7.49	-7.50
128598	-7.38	-7.39
128607	-7.36	-7.37
128616	-7.30	-7.31
128625	-7.07	-7.07
128634	-7.17	-7.18
128643	-7.39	-7.40
128690	-7.91	-7.92
128739	-7.77	-7.78
128787	-7.84	-7.85
128834	-7.50	-7.52
128883	-7.31	-7.33
128933	-7.20	-7.22
128985	-7.27	-7.29
129038	-7.19	-7.21
129089	-7.31	-7.33
129138	-7.25	-7.28
129186	-7.15	-7.17
129233	-6.81	-6.84
129279	-6.89	-6.92
129326	-7.07	-7.10
129373	-6.86	-6.89
129420	-6.78	-6.82
129467	-6.74	-6.78
129514	-6.84	-6.88
129560	-6.77	-6.81
129607	-6.74	-6.79
129653	-6.70	-6.76
129698	-6.66	-6.72
129744	-6.48	-6.54
129792	-6.80	-6.87
129839	-6.38	-6.45
129885	-6.31	-6.39
129931	-6.32	-6.40
129977	-6.40	-6.49
130023	-6.44	-6.54
130069	-6.32	-6.41
130115	-6.55	-6.65
130161	-6.49	-6.60
130206	-6.46	-6.57
130251	-6.71	-6.83
130297	-6.41	-6.53
130342	-6.32	-6.45
130388	-6.28	-6.42
130433	-6.44	-6.58
130479	-6.35	-6.50
130524	-6.62	-6.78
130568	-6.85	-7.01
130611	-6.72	-6.89
130656	-6.83	-7.00
130700	-6.81	-7.00
130744	-7.04	-7.24
130788	-6.94	-7.14
130831	-6.74	-6.95
130874	-6.73	-6.95
130917	-6.81	-7.03
130960	-6.75	-6.98
131002	-6.80	-7.04
131045	-7.01	-7.25
131088	-6.98	-7.24
131132	-6.95	-7.21
131175	-7.14	-7.41
131219	-7.17	-7.45
131263	-7.07	-7.35
131307	-7.21	-7.51
131351	-7.18	-7.48
131396	-6.96	-7.27
131442	-6.97	-7.29
131487	-6.92	-7.25
131531	-6.70	-7.04
131574	-6.95	-7.29
131619	-6.97	-7.33
131664	-6.92	-7.28
131709	-6.77	-7.14
131753	-6.95	-7.33
131797	-6.93	-7.32
131841	-6.86	-7.26
131885	-6.77	-7.18
131929	-6.94	-7.36
131973	-6.98	-7.41
132016	-6.85	-7.28
132057	-6.78	-7.22
132103	-6.71	-7.16
132166	-6.54	-7.00
139249	-7.80	-8.82
139307	-7.74	-8.76
139365	-7.74	-8.76
139424	-7.73	-8.74
139482	-7.90	-8.92
139541	-8.00	-9.01
139599	-8.07	-9.08
139657	-8.10	-9.11
139715	-8.30	-9.30
139772	-8.39	-9.39
139830	-8.45	-9.45
139886	-8.27	-9.27
139943	-8.58	-9.58
140000	-8.42	-9.41
140056	-8.03	-9.02
140113	-8.34	-9.33
140170	-8.19	-9.18
140227	-8.10	-9.08
140285	-8.07	-9.06
140343	-7.90	-8.88
140401	-8.35	-9.33
140458	-8.47	-9.45
140515	-8.44	-9.42
140571	-8.28	-9.26
140628	-8.10	-9.07
140685	-7.61	-8.58
140741	-7.66	-8.63
140798	-7.92	-8.89
140856	-7.84	-8.81
140913	-7.83	-8.79
140970	-7.67	-8.63
141028	-7.83	-8.80
141085	-7.93	-8.89
141142	-7.85	-8.81
141198	-7.93	-8.89
141254	-7.89	-8.84
141310	-7.52	-8.47
141366	-7.82	-8.77
141422	-7.82	-8.76
141479	-7.89	-8.84
141536	-7.80	-8.75
141595	-7.92	-8.87
141654	-8.01	-8.95
141713	-8.00	-8.94
141773	-7.93	-8.87
141833	-7.88	-8.81
141892	-7.94	-8.87
141951	-7.83	-8.76
142010	-7.83	-8.75
142067	-7.79	-8.72
142123	-7.94	-8.86
142179	-8.04	-8.96
142234	-7.79	-8.72
142290	-7.82	-8.74
142345	-7.86	-8.78
142401	-7.90	-8.82
142457	-7.93	-8.85
142513	-7.91	-8.82
143301	-8.22	-9.11
143357	-7.92	-8.81
143412	-7.96	-8.85
143467	-8.30	-9.19
143522	-8.17	-9.06
143578	-7.99	-8.88
143635	-8.10	-8.99
143693	-8.23	-9.12
143751	-8.22	-9.10
143809	-8.13	-9.02
143866	-7.93	-8.82
143922	-8.00	-8.88
143978	-7.94	-8.82
144034	-7.82	-8.70
144091	-7.93	-8.81
144148	-8.04	-8.92
144205	-8.16	-9.04
144261	-8.15	-9.03
144316	-8.05	-8.93
144371	-8.05	-8.93
144426	-7.99	-8.87
144482	-8.00	-8.88
144540	-8.08	-8.95
144599	-8.03	-8.91
144658	-8.01	-8.88
144716	-8.18	-9.06
144831	-7.90	-8.77
144895	-8.01	-8.89
144968	-7.74	-8.62
145055	-7.81	-8.68
145153	-7.64	-8.52
145260	-8.05	-8.93
145374	-8.03	-8.91
145496	-8.09	-8.97
145643	-8.04	-8.93
145835	-7.91	-8.80
146093	-7.92	-8.82
146423	-7.98	-8.89
146785	-7.79	-8.72
147124	-7.77	-8.71
147387	-7.91	-8.86
147536	-7.89	-8.85
147596	-7.82	-8.78
147607	-7.65	-8.62
147611	-7.82	-8.79
147639	-7.95	-8.92
147691	-7.85	-8.82
147753	-7.79	-8.76
147816	-7.89	-8.86
147870	-7.72	-8.69
147915	-7.71	-8.69
147955	-7.76	-8.74
147993	-7.86	-8.84
148030	-8.02	-9.00
148066	-8.00	-8.99
148102	-7.92	-8.91
148134	-7.86	-8.85
148163	-7.99	-8.98
148190	-8.10	-9.09
148215	-7.99	-8.98
148241	-7.89	-8.88
148267	-7.67	-8.66
148295	-7.72	-8.71
148323	-8.12	-9.11
148351	-8.08	-9.08
148379	-8.07	-9.06
148407	-7.75	-8.75
148434	-7.91	-8.91
148487	-7.94	-8.94
148538	-8.03	-9.03
148589	-8.02	-9.02
148641	-7.86	-8.87
148695	-7.90	-8.91
148751	-7.90	-8.90
148810	-7.90	-8.91
148869	-8.03	-9.04
148924	-8.21	-9.22
148977	-8.05	-9.06
149026	-8.13	-9.14
149073	-7.92	-8.93
149119	-8.06	-9.07
149167	-7.90	-8.91
149218	-8.14	-9.15
149272	-8.02	-9.03
149328	-8.23	-9.24
149382	-8.17	-9.18
149435	-7.92	-8.93
149486	-8.22	-9.23
149535	-7.85	-8.86
149585	-7.75	-8.77
149637	-7.50	-8.52
149691	-7.95	-8.97
149744	-7.99	-9.01
149797	-7.90	-8.92
149850	-8.00	-9.02
149903	-8.09	-9.11
149954	-8.39	-9.41
150003	-8.34	-9.36
150052	-8.05	-9.06
150101	-8.03	-9.05
150157	-8.13	-9.15
150217	-8.27	-9.29
150273	-8.05	-9.07
150322	-7.72	-8.74
150368	-7.78	-8.80
150415	-7.62	-8.64
150464	-7.74	-8.76
150515	-7.90	-8.92
150562	-7.66	-8.68
150607	-7.45	-8.47
150653	-7.54	-8.56
150704	-7.50	-8.52
150757	-7.38	-8.40
150812	-7.30	-8.32
150867	-7.30	-8.31
150921	-7.46	-8.47
150971	-7.59	-8.61
151020	-7.48	-8.50
151070	-7.65	-8.67
151123	-7.49	-8.50
151178	-7.54	-8.56
151235	-7.43	-8.45
151288	-7.49	-8.50
151340	-7.56	-8.58
151394	-7.68	-8.70
151452	-7.49	-8.50
151509	-7.46	-8.47
151561	-7.84	-8.85
151609	-7.79	-8.80
151656	-7.72	-8.73
151709	-7.84	-8.85
151766	-7.70	-8.71
151820	-7.69	-8.70
151869	-7.81	-8.82
151917	-7.86	-8.86
151966	-7.99	-9.00
152017	-8.31	-9.31
152071	-8.19	-9.20
152126	-8.00	-9.00
152181	-8.09	-9.09
152235	-7.80	-8.81
152288	-7.68	-8.68
152340	-7.61	-8.61
152391	-7.57	-8.57
152444	-7.47	-8.47
152499	-7.66	-8.66
152555	-7.70	-8.69
152609	-8.02	-9.01
152662	-7.78	-8.77
152713	-8.00	-8.99
152762	-7.76	-8.75
152810	-8.02	-9.00
152860	-7.82	-8.81
152910	-7.78	-8.76
152961	-7.74	-8.72
153011	-7.82	-8.79
153064	-7.69	-8.67
153120	-7.76	-8.74
153175	-7.74	-8.71
153228	-7.78	-8.74
153279	-7.48	-8.44
153328	-7.54	-8.50
153379	-7.66	-8.61
153430	-7.81	-8.76
153480	-7.71	-8.66
153528	-7.61	-8.56
153580	-7.70	-8.64
153635	-7.88	-8.82
153690	-7.95	-8.89
153741	-7.93	-8.86
153790	-8.03	-8.95

Table S5. (cont'd)

WR12-12

FINAL AGE	d18O	Ice-corr d18O
113874	-9.23	-9.40
113965	-8.64	-8.81
114055	-8.76	-8.92
114146	-8.74	-8.89
114237	-8.89	-9.04
114328	-8.98	-9.13
114419	-8.96	-9.10
114510	-8.98	-9.12
114601	-9.07	-9.20
114692	-9.01	-9.14
114783	-9.21	-9.34
114873	-9.01	-9.13
114964	-8.52	-8.64
115055	-8.61	-8.73
115146	-8.62	-8.74
115238	-8.59	-8.71
115330	-8.61	-8.73
115422	-8.59	-8.70
115515	-8.63	-8.74
115607	-8.63	-8.74
115699	-8.95	-9.05
115791	-8.97	-9.07
115883	-9.02	-9.12
115975	-8.88	-8.97
116067	-8.74	-8.83
116159	-8.69	-8.78
116251	-8.56	-8.65
116343	-8.51	-8.60
116435	-8.43	-8.51
116525	-8.45	-8.53
116616	-8.51	-8.59
116705	-8.34	-8.41
116795	-8.50	-8.57
116884	-8.39	-8.46
116973	-8.09	-8.16
117062	-8.22	-8.29
117107	-8.32	-8.39
117151	-8.33	-8.39
117196	-8.22	-8.28
117240	-8.25	-8.31
117285	-8.30	-8.36
117329	-8.30	-8.35
117374	-8.24	-8.30
117418	-8.21	-8.26
117463	-8.31	-8.36
117507	-8.39	-8.44
117552	-8.41	-8.45
117596	-8.44	-8.49
117641	-8.52	-8.57
117685	-8.45	-8.50
117730	-8.46	-8.51
117774	-8.56	-8.60
117819	-8.44	-8.48
117863	-8.42	-8.46
117907	-8.40	-8.44
117951	-8.36	-8.39
117995	-8.55	-8.58
118039	-8.45	-8.48
118083	-8.61	-8.64
118127	-8.49	-8.52
118171	-8.34	-8.37
118215	-8.47	-8.49
118259	-8.41	-8.44
118304	-8.59	-8.62
118348	-8.57	-8.59
118393	-8.51	-8.53
118437	-8.51	-8.54
118482	-8.53	-8.56
118526	-8.56	-8.58
118570	-8.56	-8.58
118614	-8.47	-8.49
118658	-8.55	-8.57
118702	-8.53	-8.55
118746	-8.47	-8.48
118790	-8.41	-8.42
118834	-8.28	-8.29
118877	-8.38	-8.40
118921	-8.47	-8.48
118965	-8.47	-8.48
119009	-8.52	-8.53
119053	-8.61	-8.62
119097	-8.63	-8.64
119142	-8.36	-8.37
119186	-8.39	-8.40
119230	-8.40	-8.40
119274	-8.56	-8.57
119318	-8.46	-8.47
119362	-8.61	-8.62
119405	-8.65	-8.65
119449	-8.70	-8.70
119493	-8.58	-8.58
119536	-8.66	-8.66
119580	-8.74	-8.74
119623	-8.71	-8.71
119667	-8.76	-8.76
119710	-8.72	-8.72
119754	-9.00	-9.00
119797	-9.06	-9.06
119840	-9.01	-9.01
119884	-9.01	-9.01
119927	-9.02	-9.02
119970	-8.98	-8.97
120014	-9.06	-9.05
120057	-9.10	-9.09
120101	-9.18	-9.17
120144	-9.19	-9.19
120188	-9.26	-9.26
120231	-9.33	-9.32
120275	-9.31	-9.31
120318	-9.14	-9.13
120362	-9.24	-9.23
120405	-9.27	-9.26
120448	-9.32	-9.31
120492	-9.31	-9.30
120535	-9.31	-9.30
120579	-9.34	-9.33
120622	-9.16	-9.15
120666	-9.28	-9.26
120709	-9.24	-9.23
120753	-9.31	-9.30
120797	-9.30	-9.29
120841	-9.38	-9.37
120885	-9.35	-9.34
120929	-9.31	-9.30
120973	-9.45	-9.43
121016	-9.51	-9.50
121060	-9.46	-9.45
121103	-9.55	-9.54
121147	-9.42	-9.40
121190	-9.66	-9.64
121233	-9.49	-9.48
121277	-9.49	-9.48
121320	-9.27	-9.26
121364	-9.05	-9.03
121407	-8.92	-8.90

FINAL AGE	d18O	Ice-corr d18O
121320	-9.27	-9.26
121364	-9.05	-9.03
121407	-8.92	-8.90
121451	-8.93	-8.91
121494	-8.96	-8.94
121538	-8.90	-8.88
121581	-8.85	-8.83
121625	-8.84	-8.82
121668	-8.85	-8.83
121711	-8.80	-8.78
121754	-8.82	-8.79
121796	-8.77	-8.75
121838	-8.57	-8.54
121877	-8.71	-8.68
121915	-8.75	-8.73
121950	-8.76	-8.74
121983	-8.80	-8.78
122013	-8.97	-8.94
122039	-8.98	-8.96
122065	-8.82	-8.80
122093	-8.71	-8.69
122112	-8.67	-8.64
122132	-8.68	-8.65
122159	-8.57	-8.54
122192	-8.56	-8.54
122234	-8.65	-8.62
122284	-8.75	-8.72
122340	-8.68	-8.65
122396	-8.57	-8.54
122447	-8.53	-8.50
122489	-8.49	-8.46
122516	-8.46	-8.43
122524	-8.35	-8.32
122525	-8.47	-8.44
122525	-8.50	-8.47
122525	-8.44	-8.41
122526	-8.42	-8.38
122526	-8.50	-8.47
122526	-8.64	-8.61
122526	-8.63	-8.60
122527	-8.50	-8.47
122527	-8.53	-8.50
122569	-8.41	-8.38
122647	-8.49	-8.46
122754	-8.54	-8.51
122885	-8.53	-8.49
123110	-8.49	-8.45
123424	-8.34	-8.30
123745	-8.51	-8.46
124061	-8.32	-8.27
124361	-8.34	-8.28
124646	-8.40	-8.35
124920	-8.33	-8.28
125185	-8.26	-8.20
125445	-8.17	-8.12
125702	-8.15	-8.10
125960	-8.13	-8.09
126221	-7.89	-7.85
126489	-7.68	-7.65
126763	-7.60	-7.58
127039	-7.78	-7.76
127317	-7.83	-7.81
127594	-7.71	-7.70
127868	-7.46	-7.46
128139	-7.25	-7.25
128403	-7.24	-7.25
128659	-7.19	-7.20
128911	-7.13	-7.14
129162	-6.97	-7.00
129415	-6.73	-6.77
129674	-6.66	-6.72
129942	-6.77	-6.85
130223	-6.62	-6.74
130519	-6.48	-6.63
130833	-6.45	-6.65
131155	-6.48	-6.74
131473	-6.57	-6.89
131775	-6.53	-6.91
132050	-6.60	-7.04
132201	-6.48	-6.95
132294	-6.39	-6.88
132355	-6.23	-6.73
132381	-6.33	-6.83
132382	-6.52	-7.02
132382	-6.64	-7.14
132383	-6.85	-7.36
132383	-7.01	-7.51
132383	-6.72	-7.22
132384	-7.02	-7.52
132385	-7.11	-7.62
132385	-7.06	-7.57
132402	-6.91	-7.42
132431	-6.89	-7.40
132466	-6.93	-7.45
132505	-6.90	-7.43
132545	-6.92	-7.45
132583	-6.77	-7.31
132616	-6.99	-7.54
132643	-6.96	-7.51
132688	-6.82	-7.38
132730	-6.71	-7.28
132768	-6.71	-7.28
132803	-6.61	-7.19
132838	-6.70	-7.29
132875	-6.63	-7.22
132915	-6.66	-7.26
132958	-6.50	-7.11
133003	-6.48	-7.10
133050	-6.45	-7.07
133098	-6.42	-7.06
133145	-6.55	-7.20
133192	-6.70	-7.36
133239	-6.92	-7.59
133326	-7.11	-7.79
133368	-7.39	-8.08
133408	-7.41	-8.10
133448	-7.48	-8.17
133488	-7.45	-8.16
133527	-7.29	-8.00
133566	-7.38	-8.10
133606	-7.29	-8.02
133645	-7.40	-8.13
133683	-7.30	-8.04
133721	-7.02	-7.76
133757	-6.81	-7.56
133791	-6.77	-7.53
133822	-6.82	-7.58
133851	-6.78	-7.55
133876	-6.95	-7.72
133899	-6.92	-7.70
133920	-6.78	-7.56
133940	-6.66	-7.45
133960	-6.61	-7.40
133981	-6.56	-7.35
134003	-6.69	-7.49

FINAL AGE	d18O	Ice-corr d18O
133960	-6.61	-7.40
133981	-6.56	-7.35
134003	-6.69	-7.49
134029	-6.90	-7.70
134057	-6.98	-7.79
134088	-7.06	-7.87
134122	-7.14	-7.95
134158	-7.09	-7.91
134197	-7.00	-7.82
134237	-7.03	-7.86
134278	-7.04	-7.88
134321	-7.09	-7.93
134364	-7.12	-7.98
134407	-7.12	-7.98
134452	-7.18	-8.05
134497	-7.04	-7.92
134543	-7.06	-7.94
134590	-7.02	-7.91
134637	-6.99	-7.89
134685	-6.99	-7.90
134734	-6.91	-7.82
134784	-7.00	-7.92
134834	-7.07	-8.00
134885	-7.10	-8.04
134936	-7.01	-7.96
134987	-7.20	-8.15
135039	-7.40	-8.36
135090	-7.42	-8.39
135141	-7.32	-8.30
135192	-7.22	-8.20
135243	-7.06	-8.04
135294	-6.94	-7.94
135345	-7.12	-8.12
135397	-7.11	-8.12
135448	-7.13	-8.15
135500	-7.17	-8.19
135553	-7.12	-8.15
135606	-7.28	-8.31
135659	-7.38	-8.41
135713	-7.31	-8.35
135767	-7.27	-8.32
135822	-7.14	-8.19
135877	-7.22	-8.27
135932	-7.11	-8.17
135988	-7.10	-8.17
136044	-7.08	-8.15
136100	-7.09	-8.16
136156	-7.00	-8.07
136212	-7.15	-8.22
136268	-6.96	-8.05
136325	-6.87	-7.95
136381	-6.82	-7.90
136437	-6.92	-8.01
136493	-6.97	-8.06
136549	-7.03	-8.12
136605	-6.91	-8.00
136660	-6.98	-8.08
136716	-7.00	-8.10
136771	-7.00	-8.10
136826	-6.98	-8.08
136881	-6.98	-8.07
136935	-7.22	-8.32
136990	-7.30	-8.40
137044	-7.31	-8.40
137099	-7.12	-8.22
137154	-7.03	-8.13
137209	-6.99	-8.08
137265	-6.98	-8.08
137320	-7.03	-8.12
137377	-7.07	-8.17
137434	-7.27	-8.36
137490	-7.27	-8.36
137548	-7.29	-8.38
137605	-7.40	-8.49
137662	-7.49	-8.57
137720	-7.42	-8.51
137777	-7.30	-8.38
137835	-7.30	-8.38
137892	-7.25	-8.33
137950	-7.09	-8.16
138008	-7.22	-8.29
138067	-7.33	-8.40
138125	-7.26	-8.33
138184	-7.10	-8.17
138244	-7.11	-8.18
138304	-7.17	-8.23
138365	-7.38	-8.44
138425	-7.45	-8.50
138486	-7.43	-8.48
138547	-7.40	-8.45
138609	-7.33	-8.38
138670	-7.17	-8.22
138731	-7.25	-8.30
138793	-7.04	-8.09
138854	-7.06	-8.10
138977	-7.22	-8.25
139100	-7.12	-8.15
139223	-6.96	-7.98
139346	-6.78	-7.80
139470	-6.82	-7.83
139596	-6.73	-7.74
139724	-6.98	-7.99
139854	-6.98	-7.98
139989	-6.88	-7.87
140129	-7.18	-8.18
140276	-7.34	-8.32
140427	-7.69	-8.67
140582	-7.72	-8.70
140738	-7.76	-8.73
140892	-7.75	-8.71
141044	-7.73	-8.69
141194	-7.85	-8.80
141344	-7.97	-8.93
141494	-7.95	-8.90
141645	-7.69	-8.63
141795	-7.71	-8.65
141943	-7.81	-8.74
142088	-8.03	-8.95
142230	-7.98	-8.90
142370	-8.04	-8.96
142508	-8.00	-8.91
142644	-7.97	-8.88
142779	-7.86	-8.76
142913	-7.91	-8.82
143046	-7.81	-8.71
143178	-7.76	-8.66
143310	-7.95	-8.84
143440	-7.97	-8.86
143571	-7.87	-8.76
143702	-7.85	-8.73
143833	-7.92	-8.81
143964	-7.94	-8.82
144096	-7.93	-8.81
144228	-7.91	-8.78
144361	-7.80	-8.68

Table S5. (cont'd)

FC12-14

FINAL AGE	d18O	Ice-corr d18O
73756	-9.74	-10.15
73848	-10.10	-10.50
73939	-10.07	-10.46
74031	-10.37	-10.75
74122	-10.31	-10.69
74214	-10.31	-10.68
74305	-10.29	-10.66
74397	-10.18	-10.54
74488	-10.20	-10.56
74580	-10.38	-10.73
74672	-10.38	-10.73
74763	-10.25	-10.59
74855	-10.32	-10.66
74946	-10.39	-10.73
75038	-10.47	-10.81
75129	-10.45	-10.78
75221	-10.20	-10.54
75312	-10.43	-10.76
75404	-10.40	-10.73
75495	-10.13	-10.46
75587	-10.25	-10.58
75679	-10.17	-10.51
75770	-10.19	-10.52
75862	-10.16	-10.49
75953	-9.91	-10.24
76045	-10.06	-10.39
76136	-9.63	-9.96
76228	-9.71	-10.04
76319	-9.56	-9.88
76411	-9.05	-9.38
76503	-9.07	-9.39
76594	-9.29	-9.62
76686	-9.42	-9.74
76777	-9.26	-9.57
76869	-9.31	-9.62
76960	-9.36	-9.67
77052	-9.35	-9.66
77143	-9.12	-9.42
77235	-9.18	-9.47
77326	-9.27	-9.56
77418	-9.84	-10.12
77510	-9.67	-9.96
77601	-9.44	-9.71
77693	-9.77	-10.04
77784	-9.67	-9.94
77876	-9.59	-9.85
77967	-9.66	-9.91
78059	-9.54	-9.79
78150	-9.54	-9.78
78242	-9.58	-9.82
78334	-9.79	-10.02
78425	-9.59	-9.82
78517	-9.44	-9.66
78608	-9.50	-9.72
78700	-9.57	-9.78
78791	-9.40	-9.61
78883	-9.36	-9.56
78974	-9.35	-9.55
79066	-9.25	-9.44
79158	-9.38	-9.57
79249	-9.25	-9.43
79341	-9.36	-9.55
79432	-9.19	-9.37
79524	-9.17	-9.35
79615	-9.07	-9.24
79707	-9.18	-9.36
79798	-9.19	-9.36
79890	-9.08	-9.24
79981	-8.94	-9.11
80073	-8.92	-9.09
80165	-9.08	-9.25
80256	-9.03	-9.19
80348	-8.87	-9.03
80439	-8.83	-8.99
80531	-8.80	-8.96
80622	-8.93	-9.09
80714	-8.91	-9.07
80805	-9.02	-9.18
80897	-9.03	-9.19
80989	-8.91	-9.07
81080	-8.77	-8.93
81172	-8.96	-9.12
81263	-8.59	-8.75
81355	-9.22	-9.38
81446	-8.91	-9.07
81538	-9.16	-9.32
81629	-8.98	-9.15
81721	-8.95	-9.12
81812	-8.77	-8.94
81904	-9.00	-9.17
81996	-8.70	-8.87
82087	-9.00	-9.17
82179	-8.95	-9.12
82270	-8.78	-8.96
82362	-8.97	-9.14
82453	-8.86	-9.03
82545	-8.90	-9.08
82636	-8.72	-8.90
82728	-8.49	-8.68
82820	-8.63	-8.81
82911	-8.57	-8.76
83003	-8.61	-8.80
83094	-8.56	-8.75
83186	-8.95	-9.16
83277	-8.50	-8.71
83369	-8.85	-9.06
83460	-8.98	-9.20
83552	-8.31	-8.53
83644	-8.78	-9.01
83735	-8.41	-8.64
83827	-8.72	-8.96
83918	-8.29	-8.53
84010	-8.37	-8.61
84101	-8.60	-8.85
84193	-8.49	-8.75
84284	-8.47	-8.73
84376	-8.26	-8.53
84467	-8.39	-8.66
84559	-8.99	-9.27
84651	-8.88	-9.16
84742	-9.09	-9.38
84834	-8.87	-9.16
84925	-8.65	-8.95
85017	-8.56	-8.86
85108	-8.43	-8.74
85200	-8.57	-8.89
85291	-8.78	-9.09
85383	-8.63	-8.95
85475	-8.74	-9.07
85566	-8.70	-9.04
85658	-8.76	-9.10
85749	-8.63	-8.98
85841	-8.74	-9.09
85932	-8.98	-9.33
86024	-9.20	-9.56

FINAL AGE	d18O	Ice-corr d18O
86115	-9.33	-9.69
86207	-9.24	-9.61
86298	-8.90	-9.27
86390	-8.80	-9.17
86482	-8.73	-9.11
86573	-8.69	-9.07
86665	-8.80	-9.19
86756	-8.33	-8.71
86848	-8.62	-9.01
86939	-8.74	-9.14
87031	-8.86	-9.26
87122	-9.06	-9.46
87214	-8.91	-9.31
129394	-7.94	-7.98
129462	-7.83	-7.87
129530	-7.29	-7.34
129599	-7.07	-7.12
129667	-7.03	-7.08
129736	-6.84	-6.91
129806	-6.58	-6.65
129875	-6.50	-6.58
129944	-6.39	-6.47
130014	-6.45	-6.54
130083	-6.46	-6.55
130152	-6.44	-6.55
130221	-6.41	-6.53
130290	-6.52	-6.64
130358	-6.50	-6.63
130426	-6.67	-6.82
130494	-6.45	-6.60
130562	-6.43	-6.59
130698	-6.39	-6.57
130765	-6.49	-6.69
130833	-6.41	-6.61
130901	-6.38	-6.60
130968	-6.32	-6.55
131035	-6.42	-6.66
131102	-6.56	-6.81
131169	-6.59	-6.86
131235	-6.57	-6.85
131301	-6.55	-6.84
131366	-6.53	-6.83
131432	-6.67	-6.99
131497	-6.84	-7.17
131562	-6.85	-7.20
131628	-6.69	-7.04
131694	-6.77	-7.14
131760	-6.72	-7.11
131826	-6.74	-7.14
131894	-6.73	-7.14
131961	-6.50	-6.92
132029	-6.55	-6.99
132098	-6.36	-6.81
132167	-6.46	-6.92
132236	-6.45	-6.93
132305	-6.52	-7.01
132375	-6.56	-7.07
132445	-6.61	-7.13
132515	-6.87	-7.40
132586	-6.87	-7.42
132657	-6.73	-7.29
132729	-6.74	-7.31
132802	-6.66	-7.24
132875	-6.71	-7.30
132949	-6.73	-7.34
133024	-6.91	-7.53
133099	-6.90	-7.54
133175	-7.07	-7.72
133251	-7.10	-7.76
133328	-6.89	-7.57
133404	-7.03	-7.73
133481	-6.94	-7.64
133558	-7.09	-7.81
133635	-6.90	-7.63
133712	-6.74	-7.48
133789	-6.75	-7.50
133867	-7.08	-7.85
133945	-7.11	-7.90
134023	-7.22	-8.02
134102	-7.35	-8.16
134181	-7.19	-8.02
134261	-7.03	-7.87
134340	-6.92	-7.78
134420	-6.97	-7.84
134500	-6.81	-7.68
134579	-6.97	-7.86
134657	-7.03	-7.94
134736	-6.91	-7.82
134813	-6.82	-7.75
134890	-6.69	-7.63
134966	-6.82	-7.77
135041	-7.02	-7.98
135116	-7.09	-8.06
135191	-7.23	-8.21
135266	-7.13	-8.12
135341	-7.28	-8.28
135415	-7.19	-8.20
135490	-7.20	-8.21
135564	-7.21	-8.24
135639	-7.22	-8.26
135713	-7.19	-8.23
135787	-7.26	-8.31
135861	-7.16	-8.22
136009	-7.15	-8.22
136082	-7.20	-8.27
136156	-7.18	-8.25
136230	-7.46	-8.54
136305	-7.40	-8.48
136381	-7.39	-8.48
136457	-7.38	-8.47
136535	-7.50	-8.60
136613	-7.21	-8.31
136694	-7.08	-8.18
136775	-6.98	-8.08
136857	-7.05	-8.14
136939	-6.92	-8.01
137022	-6.94	-8.03
137106	-7.08	-8.18
137190	-7.02	-8.12
137274	-7.09	-8.19
137357	-7.21	-8.30
137441	-7.17	-8.26
137524	-7.40	-8.49
137607	-7.16	-8.24
137689	-7.05	-8.14
137770	-7.04	-8.12
137850	-7.18	-8.26
137929	-7.09	-8.17
138007	-7.17	-8.24
138084	-6.89	-7.96
138160	-6.75	-7.82
138236	-6.87	-7.93
138311	-6.86	-7.92
138385	-7.06	-8.12
138459	-7.10	-8.15

FINAL AGE	d18O	Ice-corr d18O
138533	-7.11	-8.16
138607	-7.06	-8.11
138680	-7.00	-8.04
138753	-7.13	-8.17
138825	-7.31	-8.35
138897	-7.22	-8.26
138969	-7.22	-8.25
139040	-7.08	-8.11
139111	-7.16	-8.19
139182	-7.18	-8.21
139252	-7.02	-8.05
139322	-7.05	-8.07
139392	-7.33	-8.34
139462	-7.43	-8.44
139532	-7.45	-8.47
139602	-7.36	-8.37
139672	-7.43	-8.44
139742	-7.27	-8.28
139812	-7.03	-8.03
139883	-7.09	-8.09
139953	-6.98	-7.97
140024	-7.08	-8.07
140095	-7.00	-7.99
140166	-6.99	-7.98
140237	-7.11	-8.10
140309	-7.17	-8.15
140380	-7.38	-8.37
140451	-7.27	-8.25
140522	-7.53	-8.51
140593	-7.40	-8.37
140663	-7.46	-8.44
140733	-7.47	-8.45
140802	-7.40	-8.37
140871	-7.50	-8.46
140939	-7.31	-8.28
141007	-7.40	-8.36
141075	-7.37	-8.33
141210	-7.47	-8.43
141345	-7.59	-8.54
141481	-7.43	-8.37
141616	-7.47	-8.41
141750	-7.52	-8.46
141883	-7.38	-8.31
142016	-7.59	-8.52
142147	-7.58	-8.51
142279	-7.34	-8.26
142411	-7.34	-8.26
142544	-7.52	-8.44
142677	-7.75	-8.65
142809	-7.65	-8.55
142939	-7.52	-8.43
143067	-7.68	-8.58
143193	-7.92	-8.82
143317	-7.87	-8.76
143441	-7.87	-8.76
143564	-7.79	-8.68
143687	-7.83	-8.71
143808	-7.99	-8.87
143929	-8.10	-8.99
144048	-7.85	-8.73
144167	-7.64	-8.52
144286	-7.89	-8.77
144405	-7.87	-8.74
144524	-7.89	-8.77
144644	-7.89	-8.77
144765	-7.78	-8.65
144889	-7.90	-8.77
145014	-8.01	-8.88
145141	-8.05	-8.93
145266	-7.94	-8.82
145390	-7.94	-8.82
145512	-7.87	-8.76
145630	-8.09	-8.97
145745	-7.96	-8.85
145855	-7.83	-8.72
145962	-7.93	-8.82
146069	-8.01	-8.91
146178	-7.80	-8.70
146293	-7.86	-8.76
146414	-7.75	-8.66
146540	-7.85	-8.77
146668	-7.89	-8.81
146797	-7.83	-8.76
146927	-7.86	-8.80
147055	-7.91	-8.85
147184	-7.82	-8.77
147312	-7.84	-8.79
147440	-7.70	-8.65
147568	-7.86	-8.82
147695	-7.77	-8.74
147823	-7.71	-8.68
147950	-7.60	-8.58
148078	-7.51	-8.50
148206	-7.77	-8.76
148334	-7.89	-8.88
148461	-7.72	-8.72
148589	-7.72	-8.72
148717	-7.60	-8.61
148845	-7.80	-8.80
148973	-7.81	-8.82
149101	-7.73	-8.75
149228	-7.85	-8.87
149355	-7.79	-8.80
149481	-7.86	-8.88
149608	-7.78	-8.80
149735	-7.60	-8.62
149862	-7.69	-8.71
149991	-7.59	-8.61
150120	-7.59	-8.61
150250	-7.70	-8.72
150379	-7.61	-8.63
150508	-7.76	-8.78
150637	-7.70	-8.72
150765	-7.69	-8.70
150894	-7.77	-8.79
151022	-7.88	-8.90
151150	-7.90	-8.91
151279	-7.86	-8.87
151406	-7.67	-8.68
151534	-7.72	-8.73
151661	-7.62	-8.63
151788	-7.55	-8.56
151916	-7.74	-8.74
152044	-8.01	-9.01
152171	-7.87	-8.87
152299	-7.89	-8.89
152427	-7.79	-8.78
152554	-7.68	-8.67
152681	-7.83	-8.82
152809	-7.76	-8.75
152937	-7.82	-8.80
153066	-7.84	-8.82
153195	-7.69	-8.66
153323	-7.77	-8.73
153451	-7.84	-8.79

FINAL AGE	d18O	Ice-corr d18O
153578	-7.73	-8.68
153704		
153831		
153958	-7.71	-8.63
154086	-7.78	-8.68
154215	-7.93	-8.82
154343	-8.05	-8.92
154472	-7.85	-8.70
154600	-7.83	-8.68
154728	-7.64	-8.46
154856	-7.66	-8.47
154984	-7.95	-8.75
155112	-7.96	-8.73
155240	-7.97	-8.73
155368	-7.99	-8.73
155496	-7.92	-8.65
155624	-7.94	-8.66
155753	-8.14	-8.85
155881	-7.91	-8.60
156010	-7.90	-8.58
156140	-7.94	-8.62
156270	-7.85	-8.51
156400	-7.80	-8.47
156529	-7.81	-8.47
156659	-8.00	-8.66
156790	-7.92	-8.58
156922	-7.76	-8.42
157056	-7.89	-8.55
157192	-7.90	-8.57
157328	-7.94	-8.62
157464	-7.80	-8.48
157597	-8.06	-8.75
157728	-7.95	-8.65
157860	-7.97	-8.68
157995	-7.77	-8.49
158136	-7.95	-8.68
158283	-8.03	-8.77
158432	-7.82	-8.57
158578	-7.76	-8.51
158718	-7.87	-8.62
158851	-7.86	-8.62
158981	-8.00	-8.76
159110	-8.08	-8.83
159242	-7.95	-8.71
159378	-7.82	-8.57
159517	-7.91	-8.65
159657	-7.75	-8.49
159799	-8.06	-8.80
159944	-8.17	-8.90
160096	-7.94	-8.66
160431	-7.75	-8.46
160615	-7.99	-8.69
160801	-8.14	-8.83
160978	-8.00	-8.68
161138	-7.84	-8.52
161278	-8.34	-9.02
161408	-8.09	-8.76
161533	-8.12	-8.79

References:

1. Bard, E., Hamelin, B., Fairbanks, R.G., 1990. U-Th ages obtained by mass-spectrometry in corals from Barbados - sea-level during the past 130,000 years. Nature 346, 456-458.

2. Bard, E., Hamelin, B., Arnold, M., Montaggioni, L., Cabioch, G., Faure, G., Rougerie, F., 1996. Deglacial sea-level record from Tahiti corals and the timing of global meltwater discharge. Nature 382, 241-244.

3. Berger, A.L., 1978. Long-term variations of daily insolation and quaternary climatic changes. Journal of the Atmospheric Sciences 35, 2362-2367.

4. Carolin, S.A., Cobb, K.M., Adkins, J.F., Clark, B., Conroy, J.L., Lejau, S., Malang, J., Tuen, A.A., 2013. Varied Response of Western Pacific Hydrology to Climate Forcings over the Last Glacial Period. Science 340, 1564-1566.

5. Chen, J.H., Curran, H.A., White, B., Wasserburg, G.J., 1991. Precise chronology of the last interglacial period - U-234-Th-230 data from fossil coral reefs in the Bahamas. Geological Society of America Bulletin 103, 82-97.

6. Cheng, H., Edwards, R.L., Broecker, W.S., Denton, G.H., Kong, X.G., Wang, Y.J., Zhang, R., Wang, X.F., 2009. Ice Age Terminations. Science 326, 248-252.

7. Cheng, H., Edwards, R.L., Shen, C.C., Polyak, V.J., Asmerom, Y., Woodhead, J., Hellstrom, J., Wang, Y.J., Kong, X.G., Spotl, C., Wang, X.F., Alexander, E.C., 2013. Improvements in Th-230 dating, Th-230 and U-234 half-life values, and U-Th isotopic measurements by multi-collector inductively coupled plasma mass spectrometry. Earth Planet. Sci. Lett. 371, 82-91.

8. Cobb, K.M., Adkins, J.F., Partin, J.W., Clark, B., 2007. Regional-scale climate influences on temporal variations of rainwater and cave dripwater oxygen isotopes in northern Borneo. Earth Planet. Sci. Lett. 263, 207-220.

9. Coyne, M.K., Jones, B., Ford, D., 2007. Highstands during Marine Isotope Stage 5: evidence from the Ironshore Formation of Grand Cayman, British West Indies. Quaternary Science Reviews 26, 536-559.

10. Cutler, K.B., Edwards, R.L., Taylor, F.W., Cheng, H., Adkins, J., Gallup, C.D., Cutler, P.M., Burr, G.S., Bloom, A.L., 2003. Rapid sea-level fall and deep-ocean temperature change since the last interglacial period. Earth Planet. Sci. Lett. 206, 253-271.

11. Dodge, R.E., Fairbanks, R.G., Benninger, L.K., Maurrasse, F., 1983. Pleistocene sea levels from raised coral reefs of Haiti. Science 219, 1423-1425.

12. Dorale, J.A., Liu, Z.H., 2009. Limitations of Hendy test criteria in judging the paleoclimatic suitability of speleothems and the need for replication. Journal of Cave and Karst Studies 71,

73-80.

13. Dykoski, C.A., Edwards, R.L., Cheng, H., Yuan, D.X., Cai, Y.J., Zhang, M.L., Lin, Y.S., Qing, J.M., An, Z.S., Revenaugh, J., 2005. A high-resolution, absolute-dated Holocene and deglacial Asian monsoon record from Dongge Cave, China. Earth Planet. Sci. Lett. 233, 71-86.

14. Edwards, R.L., Beck, J.W., Burr, G.S., Donahue, D.J., Chappell, J.M.A., Bloom, A.L., Druffel, E.R.M., Taylor, F.W., 1993. A large drop in atmospheric C-14/C-12 and reduced melting in the Younger Dryas, documented with Th-230 ages of corals. Science 260, 962-968.

15. Epstein, S., Buchsbaum, R., Lowenstam, H.A., Urey, H.C., 1953. Revised carbonate-water isotopic temperature scale. Geological Society of America Bulletin 64, 1315-1325.

16. Esat, T.M., McCulloch, M.T., Chappell, J., Pillans, B., Omura, A., 1999. Rapid fluctuations in sea level recorded at Huon Peninsula during the penultimate deglaciation. Science 283, 197-201.

17. Fairbanks, R.G., 1989. A 17,000-year glacio-eustatic sea-level record - influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation. Nature 342, 637-642.

18. Fleming, K., Johnston, P., Zwartz, D., Yokoyama, Y., Lambeck, K., Chappell, J., 1998. Refining the eustatic sea-level curve since the Last Glacial Maximum using far- and intermediate-field sites. Earth Planet. Sci. Lett. 163, 327-342.

19. Gallup, C.D., Cheng, H., Taylor, F.W., Edwards, R.L., 2002. Direct determination of the timing of sea level change during termination II. Science 295, 310-313.

20. Hanebuth, T., Stattegger, K., Grootes, P.M., 2000. Rapid flooding of the Sunda Shelf: A late-glacial sea-level record. Science 288, 1033-1035.

21. Indermuhle, A., Stocker, T.F., Joos, F., Fischer, H., Smith, H.J., Wahlen, M., Deck, B., Mastroianni, D., Tschumi, J., Blunier, T., Meyer, R., Stauffer, B., 1999. Holocene carbon-cycle dynamics based on CO2 trapped in ice at Taylor Dome, Antarctica. Nature 398, 121-126.

22. Kawamura, K., Parrenin, F., Lisiecki, L., Uemura, R., Vimeux, F., Severinghaus, J.P., Hutterli, M.A., Nakazawa, T., Aoki, S., Jouzel, J., Raymo, M.E., Matsumoto, K., Nakata, H., Motoyama, H., Fujita, S., Goto-Azuma, K., Fujii, Y., Watanabe, O., 2007. Northern Hemisphere forcing of climatic cycles in Antarctica over the past 360,000 years. Nature 448, 912-U914.

23. Koutavas, A., Joanides, S., 2012. El Nino-Southern Oscillation extrema in the Holocene and Last Glacial Maximum. Paleoceanography 27.

24. Lea, D.W., Pak, D.K., Spero, H.J., 2000. Climate impact of late quaternary equatorial Pacific sea surface temperature variations. Science 289, 1719-1724.

25. Lemieux-Dudon, B., Blayo, E., Petit, J.-R., Waelbroeck, C., Svensson, A., Ritz, C., Barnola, J.-M., Narcisi, B.M., Parrenin, F., 2010. Consistent dating for Antarctic and Greenland ice cores. Quaternary Science Reviews 29, 8-20.

26. Ludwig, K. R., 1991. ISOPLOT-a plotting and regression program for radiogenic-isotope data. USGS Open-File Rept. 91-445.

27. McManus, J.F., Francois, R., Gherardi, J.M., Keigwin, L.D., Brown-Leger, S., 2004. Collapse and rapid resumption of Atlantic meridional circulation linked to deglacial climate changes. Nature 428, 834-837.

28. Meckler, A.N., Clarkson, M.O., Cobb, K.M., Sodemann, H., Adkins, J.F., 2012. Interglacial Hydroclimate in the Tropical West Pacific Through the Late Pleistocene. Science 336, 1301-1304.

29. Medina-Elizalde, M., 2013. A global compilation of coral sea-level benchmarks: Implications and new challenges. Earth Planet. Sci. Lett. 362, 310-318.

30. Moerman, J.W., Cobb, K.M., Adkins, J.F., Sodemann, H., Clark, B., Tuen, A.A., 2013. Diurnal to interannual rainfall delta O-18 variations in northern Borneo driven by regional hydrology. Earth Planet. Sci. Lett. 369, 108-119.

31. Monnin, E., Indermuhle, A., Dallenbach, A., Fluckiger, J., Stauffer, B., Stocker, T.F., Raynaud, D., Barnola, J.M., 2001. Atmospheric CO2 concentrations over the last glacial termination. Science 291, 112-114.

32. Muhs, D.R., Simmons, K.R., Steinke, B., 2002. Timing and warmth of the Last Interglacial period: new U-series evidence from Hawaii and Bermuda and a new fossil compilation for North America. Quaternary Science Reviews 21, 1355-1383.

33. Muhs, D.R., Simmons, K.R., Schumann, R.R., Halley, R.B., 2011. Sea-level history of the past two interglacial periods: new evidence from U-series dating of reef corals from south Florida. Quaternary Science Reviews 30, 570-590.

34. Parrenin, F., Petit, J.R., Masson-Delmotte, V., Wolff, E., Basile-Doelsch, I., Jouzel, J., Lipenkov, V., Rasmussen, S.O., Schwander, J., Severi, M., Udisti, R., Veres, D., Vinther, B.M., 2012. Volcanic synchronisation between the EPICA Dome C and Vostok ice cores (Antarctica) 0-145 kyr BP. Climate of the Past 8, 1031-1045.

35. Partin, J.W., Cobb, K.M., Adkins, J.F., Clark, B., Fernandez, D.P., 2007. Millennial-scale trends in west Pacific warm pool hydrology since the Last Glacial Maximum. Nature 449, 452-U453.

36. Peltier, W.R., Fairbanks, R.G., 2006. Global glacial ice volume and Last Glacial Maximum duration from an extended Barbados sea level record. Quaternary Science Reviews 25, 3322-3337.

37. Percival, D.B., and A.T. Walden (1993), *Spectral analysis for physical applications--Multitaper and conventional univariate techniques.* Cambridge University, 580 pp.

38. Petit, J.R., Jouzel, J., Raynaud, D., Barkov, N.I., Barnola, J.M., Basile, I., Bender, M., Chappellaz, J., Davis, M., Delaygue, G., Delmotte, M., Kotlyakov, V.M., Legrand, M., Lipenkov, V.Y., Lorius, C., Pepin, L., Ritz, C., Saltzman, E., Stievenard, M., 1999. Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. Nature 399, 429-436.

39. Scholz, D., Hoffmann, D.L., 2011. StalAge - An algorithm designed for construction of speleothem age models. Quaternary Geochronology 6, 369-382.

40. Speed, R.C., Cheng, H., 2004. Evolution of marine terraces and sea level in the last interglacial, Cave Hill, Barbados. Geological Society of America Bulletin 116, 219-232.

41. Steig, E.J., Morse, D.L., Waddington, E.D., Stuiver, M., Grootes, P.M., Mayewski, P.A., Twickler, M.S., Whitlow, S.I., 2000. Wisconsinan and Holocene climate history from an ice core at Taylor Dome, western Ross Embayment, Antarctica. Geografiska Annaler Series a-Physical Geography 82A, 213-235.

42. Stein, M., Wasserburg, G.J., Aharon, P., Chen, J.H., Zhu, Z.R., Bloom, A., Chappell, J., 1993. TIMS U-series dating and stable isotopes of the last interglacial event in Papua New Guinea. Geochimica Et Cosmochimica Acta 57, 2541-2554.

43. Stirling, C.H., Esat, T.M., McCulloch, M.T., Lambeck, K., 1995. High-precision U-series dating of corals from Western Australia and implications for the timing and duration of the last interglacial. Earth Planet. Sci. Lett. 135, 115-130.

44. Stirling, C.H., Esat, T.M., Lambeck, K., McCulloch, M.T., 1998. Timing and duration of the Last Interglacial: evidence for a restricted interval of widespread coral reef growth. Earth Planet. Sci. Lett. 160, 745-762.

45. Szabo, B.J., Ludwig, K.R., Muhs, D.R., Simmons, K.R., 1994. Th-230 ages of corals and duration of the last interglacial sea-level high stand on Oahu, Hawaii. Science 266, 93-96.

46. Thomas, A.L., Henderson, G.M., Deschamps, P., Yokoyama, Y., Mason, A.J., Bard, E., Hamelin, B., Durand, N., Camoin, G., 2009. Penultimate Deglacial Sea-Level Timing from Uranium/Thorium Dating of Tahitian Corals. Science 324, 1186-1189.

47. Thompson, W.G., Goldstein, S.L., 2005. Open-system coral ages reveal persistent suborbital sea-level cycles. Science 308, 401-404.

48. Thomson, D.J. (1982), Spectrum estimation and harmonic analysis, *Proc. IEEE, 70,* 1055–1095.

49. Visser, K., Thunell, R., Stott, L., 2003. Magnitude and timing of temperature change in the Indo-Pacific warm pool during deglaciation. Nature 421, 152-155.

50. Waelbroeck, C., Labeyrie, L., Michel, E., Duplessy, J.C., McManus, J.F., Lambeck, K., Balbon, E., Labracherie, M., 2002. Sea-level and deep water temperature changes derived from benthic foraminifera isotopic records. Quaternary Science Reviews 21, 295-305.

51. Wang, Y.J., Cheng, H., Edwards, R.L., An, Z.S., Wu, J.Y., Shen, C.C., Dorale, J.A., 2001. A high-resolution absolute-dated Late Pleistocene monsoon record from Hulu Cave, China. Science 294, 2345-2348.

52. Wang, Y.J., Cheng, H., Edwards, R.L., Kong, X.G., Shao, X.H., Chen, S.T., Wu, J.Y., Jiang, X.Y., Wang, X.F., An, Z.S., 2008. Millennial- and orbital-scale changes in the East Asian monsoon over the past 224,000 years. Nature 451, 1090-1093.

53. Yokoyama, Y., Lambeck, K., De Deckker, P., Johnston, P., Fifield, L.K., 2000. Timing of the Last Glacial Maximum from observed sea-level minima. Nature 406, 713-716.